SEVENTH ANNUAL REPORT

OF THE

NEW JERSEY STATE

gricultural Experiment Station

FOR THE YEAR

1886.

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TRENTON, N. J.:
THE JOHN L. MURPHY PUBLISHING CO., PRINTERS.
1887.

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SEVENTH ANNUAL REPORT

AGRICULTURAL
EXPERIMENT STATION.
JUL 25 1888
UNIVERSITY OF ILLINOIS.

OF THE

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Agricultural Experiment Station

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To his Excellency Leon Abbett, Governor of the State of New Jersey:

SIR—I have the honor to submit herewith the seventh annual report of the New Jersey State Agricultural Experiment Station, as required by the law establishing the Station, which was approved March 10th, 1880, and which is chapter CVI. of the laws of that year.

WILLIAM S. TAYLOR,
President.

NEW BRUNSWICK, N. J., December 31st, 1886.

104 a. d.

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JOHN W. McKELVEY, April 15th to September 20th	Third Assistant Chemist.
IRVING S. UPSON, New Brunswick	Clerk.

DAVID L. SCUDDER, New Brunswick	Laboratory Attendant.

TREASURER'S REPORT.

James Neilson, in account with the New Jersey Agricultural Experiment Station, January 1st, 1886, to January 1st, 1887:

RECEIPTS.

From State Treasurer	$11,272 10

PAYMENTS.

Salaries and pay of chemists and assistants	$7,176 06
Expenses of the Board of Managers	63 64
Stationery	211 58
Printing	401 97
Postage	594 97
Telephone service	120 50
Fuel and stoves	86 42
Gas and water	108 72
Laboratory expenses	1,010 63
Field and feeding experiments	619 00
Freight, express and cartage bills	67 02
Expenses collecting samples of fertilizers	229 29
Traveling expenses	72 85
Rent	500 00
Miscellaneous and incidental expenses	9 45
	$11,272 10

Respectfully submitted,

JAMES NEILSON,
Treasurer.

The Auditing Committee of the Experiment Station have examined the accounts of the Treasurer of said Station and find them correct.

I. M. SMALLEY,
WM. PARRY.

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    3. To study the effects of fertilizers upon Sugar Development in Sorghum.
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SEVENTH ANNUAL REPORT.

The work of the New Jersey Agricultural Experiment Station during its seventh year is herewith presented, as it is arranged under the general heads of

I. FERTILIZERS.
II. SORGHUM.
III. FODDERS AND FEEDS.
IV. PEACH TREES AND PEACHES.
V. METHODS FOR THE DETERMINATION OF NITROGEN.
VI. APPENDIX.

The largest and most responsible work of the Station, and that for which the farmers depend on it, is its publications on fertilizers, their amount, composition and comparative values. By direct correspondence with manufacturers and dealers, reports have been received of 38,678 tons of high-priced fertilizers sold to farmers during the year 1886. And it is known that there is much more sold of which we have no report. These sales represent nearly a million and a half dollars, and they are largely controlled by the Station's analyses. The sources from which the stock for fertilizers can be drawn are so numerous and spread over so many countries that the wholesale prices vary but little through the year, or indeed through successive years. The carefully prepared tables of quotations in the report are satisfactory in that they show the supply is equal to the demand without any marked increase in price. The introduction of phosphate meal as a fertilizer adds enormously to the stores from which phosphoric acid may be supplied. It is made in refining iron containing phosphorus; the quantity offered is greater than that from South Carolina rock, and it can be bought at low prices. The supply of sulphate of ammonia from coal gas could be increased to any extent, if the proper arrangements were made at the coke ovens, and the supply of potash, cheaper than it can be got from wood ashes, appears to be unlimited in some of the salt mines.

The retail prices at which manufacturers sell their standard brands remain the same through successive years. It is easier to vary the stock used so as to meet the fluctuations of its market price than to change the standard price of the mixed fertilizer sold to the farmer. It is possibly for this reason that there appears to be greater variations in the valuation of the separate constituents of the fertilizers in the retail prices than there are in the wholesale. The comparison of the wholesale and retail prices shows a somewhat greater difference than in former years. It is, however, very irregular, as will be seen by reference to the tabulated statement.

The number of brands of fertilizers analyzed at the Station laboratory during the past year is:

Complete fertilizers	150
Incomplete fertilizers	120
Miscellaneous samples (including ground bones, dissolved bones, &c.)	33

It is gratifying to be able to report that no cases of clearly proved intentions to defraud by selling worthless fertilizers have been met with this year. A few cases in which gross ignorance is shown have been brought to the notice of the Station. The closeness with which the work of the Station is watched is apparent in the greater uniformity in composition which each brand continues to have, and in the closer approach it makes to its own guarantee. It is a source of strength to the Station, and of assurance to the farmers and manufacturers, that the samples are taken by citizens of such standing that their fairness is beyond question from either side.

An attempt has been made within the year by the American Fertilizer Association to have the valuations of fertilizers omitted from the published analyses sent out by the Experiment Stations. In our Bulletin XL., which was distributed in October, the farmers were invited to send to the Station their opinions upon the subject. A considerable number of letters were received in response to this, and they were unanimous in the belief that the valuations were useful, and that their publication should be continued. It is believed that the farmers of New Jersey desire the continuance of the valuations. The system upon which the valuations are made is fully explained in the report. In the fluctuations of the market the selling prices may vary somewhat from the valuations, but as the system is uniform a comparison of the valuations published will at least show the relative values of different brands. The valuation does not profess to give the aid a fertilizer will furnish in growing a crop; that is its agricultural value, which must be determined by the farmer himself, from his knowledge of his soils and the wants of his crops. But the valuation does clear away some of the difficulties which beset the farmer in selecting what he needs for his crops and what he can omit from his purchases. In short, it will prepare the way for the intelligent farmer to buy the unmixed fertilizers and to only use such as he knows will bring him a profitable return in the crop grown by its use.

The work of the Station upon fertilizers is educational to the farmers. Each year shows a larger number of them who are using the analyses and valuations, not only to guide in their purchases, but also to enable them to judge which of the fertilizing elements can be used to profit. The field experiments, and studies of them, show plainly enough that there are cases in which fertilizers do not give returns equal to their cost. But that is due to not adapting fertilizers to the soils and to the crops to be grown, and must be corrected by the judgment of the farmer with his experience on his own soil and crops.

The field experiments open a wide ground for consideration and further experiment. The proper economy of rotations suited to the soils and the markets is well shown in some of the experiments on the College Farm. These were first begun to show the effect of the several fertilizing elements upon the growth of various staple crops, without reference to their cost in market. In this case, the benefits to be derived from them were expected to be found in the instruction given to farmers upon the fertilizers needed to favor the growth of the different crops, and of those which were not needed for that purpose. They have accomplished this end.

But it would not be profitable farm practice to continue the use of fertilizers in this way throughout an entire rotation, and this is fairly shown in the computations upon the cost of the fertilizers used and the value of the crops produced for several years. It is one of the important duties of an Experiment Station to ascertain what may be profitable in routine farming, and what may be omitted without injury, and then to publish faithfully the results and conclusions reached.

The experiments upon the growing of sorghum, and the production of sugar from it, have cleared up some of the difficulties connected with the general subject. They have been made in large fields, and in the working sugar-house, so that they represent both scientific accuracy and practical work, and they corroborate the results of preceding seasons. In the face of a market in which the price of sugar is lower than ever before known, it could hardly be expected that a profitable business should be started at once. But lines of inquiry have been marked out along which economies may be effected, sufficient in amount to make the production of sorghum and sugar one of the regular objects of farming industry in New Jersey. The investigations of the year are given in detail, and reference is hereby made to them in the body of the report. It is sufficient to say that difficulties attending the establishment of this new industry, are by no means so great or so discouraging as those which at first surrounded the production of beet sugar. That has overcome all its discouragements, and now produces more than half of all the sugar that is consumed in the world, and there is good reason for believing that sorghum sugar will, in the future, largely replace the beet.

The experiments to show the effect of fertilizers upon the growth and productiveness of peach trees are successful, and are giving great encouragement to the cultivators as well as to the consumers of this luscious fruit. By the use of chemical fertilizers, especially of muriate of potash, the trees are now kept in healthy growth and in bearing condition for many years, in the very fields where formerly, without the use of fertilizers, the lives of the trees were limited to six or seven years. On unmanured soils the foliage of the trees turned yellow, great numbers of little suckers grew out on the branches, and the trees were said to have the "Yellows" and soon died. The good effect of fertilizers upon the failing trees is so marked that many cultivators of peach trees believe there is no such disease as the "Yellows," and that their early failure is simply due to lack of proper plant-food.

The experiments lead, too, to the inquiry whether many of the cases of plant and tree failure are not due to want of proper and sufficient nutriment, rather than to peculiar diseases. It is certain that thorough and complete fertilization enables plants and trees to thrive, where, in other circumstances, they dwindle out a sickly life.

Field experiments in these cases will necessarily need to be different.

They may be planned and directed from the laboratories of the Station, but they must be carried out on farms which represent the peculiarities of the various sections, and the tillage must be managed by men familiar with the working of the class of soils to be experimented on.

The field experiments described in this year's report are intended to be in this line, and they bring out several interesting points, but they are only the beginning of what must be carried out in detail over the whole State.

Waste products to be used for fertilizers have been further experimented upon this year, with satisfactory results.

Phosphoral and other phosphates have been subjects of study in field experiments this year. They do not prove the propriety of asking for any change of the State law regarding the analysis of fertilizers. The change which has been called for by those introducing new phosphates would be in the determination of phosphoric acid soluble in solutions of citrate of ammonia to put the temperature required at 150 deg. Fahr., instead of 100 deg. Fahr., as it now is.

The field experiments in different parts of the State are also bringing out plainly the need for carrying out carefully-planned experiments to test the capabilities and the wants of the soils in different sections of the State. Small as New Jersey is, it has within its bounds all the varieties of soils from the heaviest clays to the lightest sands, and from limestone, marl and alluvial soils which are inexhaustibly rich, to those which will not grow the first crop without fertilization. It has, too, the variable soils which originated with the glacial drift, and the uniform soils which have been formed by the decay of the rocks, upon which they lie. The climate, too, varies from the maritime to the inland; from winters at the north with ice two feet thick to those at the south without ice enough to fill ice-houses; and with summers at the north six weeks shorter than at the south. Under these conditions the farming and farm products vary widely.

The analyses of fodders which have been made in the laboratory during the last year are made in response to a want which is felt by many intelligent farmers. Modern farming requires that all the products of the land shall be turned to economic use. Stock must be kept in as large numbers as can be fed from the coarse and less marketable products of the farm. The best hay and bright straw of the farm find a ready market at prices above what they are worth for feeding cattle or sheep, while corn stalks, black grass, salt grass, coarse straw, &c., are frequently wasted, though they could be profitably used for feeding stock, and the addition of cheap waste products from the mills, the grain merchants, the breweries, the distilleries, and other markets, can be mixed with these coarse farm products so as to make a complete, cheap, palatable and nutritious ration for farm animals, and the study of these will have much to do with the profits of farming. The subjects of waste products and the computation of rations have been taken up in former reports. This year's work is represented by 81 samples of fodders alone, and the results have been averaged and compared with the results of similar work in this country and in Europe. The ash analyses have also been made, so that calculations of their value for manurial purposes can be made.

FERTILIZERS.

STATISTICS OF FERTILIZERS CONSUMED IN NEW JERSEY DURING YEAR ENDING NOVEMBER 1ST, 1886.

These statistics were taken by manufacturers from their books in answer to requests made by this Station. The reports were in each case returned on printed forms, of which the following is a copy:

SALES OF COMMERCIAL FERTILIZERS.

The following is a correct statement of the number of tons of the several classes of Commercial Fertilizers sold in New Jersey by ——— ——— during the year ending November 1st, 1886:

Number of tons of Complete Manure ....
“ “ Ammoniated Superphosphate without Potash (Dissolved Bone, &c.) ....
“ “ Ground Bone ....
“ “ Kainite ....
“ “ Muriate of Potash ....
“ “ Nitrogenous Matter ....
(*a*) Ammonium Sulphate.. ....
(*b*) Sodium Nitrate.. ....
(*c*) Blood, Ammonite, &c. ....
Number of tons of Plain Superphosphates, including both Dissolved Bone Black and S. C. Acid Phosphate..............

Three firms, for business reasons, declined to make reports; several neglected to answer the Station's letters, and forty made returns of sales which aggregate *thirty-eight thousand six hundred and seventy-eight tons,* divided as follows:

	1882.	1884.	1885.	1886.
Number of tons of Complete Manure	15,941	21,894	22,421	24,498
" " Ammoniated Superphosphate without Potash (Dissolved Bone, &c.)	1,370	1,541	1,603	1,343
" " Ground Bone	2,509	3,172	2,237	2,338
" " Kainite	683	991	584	1,106
" " Muriate of Potash	144	291	331	255
" " Ammonite	719	783	250	*698
" " Ammonium Sulphate	76	54	55	21
" " Sodium Nitrate	26	40	17	24
" " Blood	244	1,581	263	....
" " Fish	228	228	....	....
" " Hair	248	574	434	723
" " Poudrette	3,450	10,200	6,000	5,000
" " Superphosphates, 30-40 per cent.	562	....	....	....
" " Superphosphates, 11-18 per cent.	3,963	5,315	....	....
" " Bone Black Superphosphate	....	....	2,488	594
" " S. C. Rock	....	....	1,124	2,078
Total	30,163	46,664	37,810	38,678

*The total number of tons, in 1886, under Ammonite, include both blood and fish, returns having been made, in many cases, without discrimination.

It is admitted that these statistics are incomplete, as they represent forty manufacturers only out of the sixty-one whose brands have this year been sampled in this State and analyzed by this Station.

This statistical work is carried out without legal authority, the data being secured only through the courtesy of those manufacturers who, year after year, at their own expense compile their reports in answer to direct requests.

The total tonnage for the year, viz., *thirty-eight thousand six hundred and seventy-eight*, falls considerably below the returns given by the railroad companies to Mr. A. de Ghequier, Secretary of the National Fertilizer Association, Baltimore, Md. These returns indicate that *forty-two thousand eight hundred and twenty-eight tons* were transported during the past year by the leading roads of New Jersey, but it is not known whether this includes stable manure, or whether much of this tonnage may not have gone into consumers' hands in neighboring States.

THE AVERAGE RETAIL PRICES FOR 1882, 1884, 1885 AND 1886.

	1882.	1884.	1885.	1886.
Complete Manure	$41 00	$38 00	$35 73	**$36 68**
Ammoniated Superphosphate without Potash (Dissolved Bone, &c.)	32 00	31 00	31 62	**29 25**
Ground Bone	37 00	36 00	31 25	**34 35**
Kainite	12 00	10 00	11 75	10 60
Muriate of Potash	41 00	38 00	42 15	42 00
Ammonite	56 00	43 00	43 00	*40 40
Ammonium Sulphate	99 00	70 50	68 50	70 00
Sodium Nitrate	76 00	54 00	52 25	58 72
Blood	56 00	43 50	38 67	....
Fish	45 00	31 50	34 66	....
Hair	10 00	11 00	10 00	10 00
Poudrette	10 00	10 00	10 00	10 00
Superphosphates with 30 to 40 per cent. Phos. Acid	75 00	....	....	....
" " 11 to 18 per cent Phos. Acid	28 50	24 50	....	....
Superphosphates made from Bone Black	....	....	29 86	25 85
" " " S. C. rock	....	....	20 31	17 75

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*The prices for blood, ammonite and fish have been averaged for the year 1886, for reason mentioned on the preceding page.

These prices represent the average retail cash cost per ton at factory depots of complete manures and unmixed stock; as a rule they exclude freight charges and cartage at consumers' depots.

The only exceptions to this rule occur in 1886, in the case of complete manures, dissolved bone and ground bone; their average retail prices include both freight and cartage. For instance, $36.68 represents the average retail cost per ton at *consumers' depots* of one hundred and thirty-eight different brands. Allowing that the expenses for freight and handling average $1 per ton, then in comparison with 1885 the prices for complete fertilizers for 1886 have remained unchanged. Calculated in a similar manner, it can be shown that during the past year the average retail price of ground bone *advanced seven per cent.*, while that for dissolved bone *declined ten per cent.;* the prices of superphosphates made from bone black and South Carolina rock also declined by approximately *thirteen per cent.*

The price per ton of muriate of potash has remained practically unchanged; kainite, however, has declined during the year by approximately *ten per cent.* Nitrate of soda *advanced twelve per cent.*, and sulphate of ammonia varied but little from its average price in 1885.

The total cash value of the reported sales of commercial fertilizers in this State during 1886 can be easily calculated from the data in the two preceding tables. Compared with the sales for previous years they are as follows:

Total value of fertilizers reported for	1882	$1,070,113 00
" " " " "	1884	1,369,004 00
" " " " "	1885	1,116,670 00
" " " " "	1886	1,181,266 00

FERTILIZERS.

In this branch of its work the Station aims to assist farmers who are in search of information regarding the purchase and use of fertilizers.

Questions referring simply to the prices and quality of brands are discussed in the chapter on *Commercial Relations*. The effects which fertilizers may produce upon the quantity and quality of a crop are shown in a following chapter on Agricultural Relations.

I.

THE COMMERCIAL RELATIONS OF FERTILIZERS.

Their Market Prices.

The Sources and Quality of their Nitrogen, Phosphoric Acid and Potash.

Their Guaranteed Chemical Composition and Relative Commercial Values.

THE MARKET PRICES OF FERTILIZERS.

The following points bear either directly or indirectly upon the average retail prices of fertilizers in this State:

1. The average *wholesale* prices of nitrogen, phosphoric acid and potash, in the crude stock out of which merchantable fertilizers are made.

2. The average *retail* prices of nitrogen, phosphoric acid and potash, in the crude stock out of which merchantable fertilizers are made.

3. The comparison between the average *wholesale* and *retail* prices of nitrogen, phosphoric acid and potash in crude stock.

1.

THE WHOLESALE PRICES OF NITROGEN, PHOSPHORIC ACID AND POTASH IN THE CRUDE STOCK, FROM WHICH MERCHANTABLE FERTILIZERS ARE MADE.

The weekly reports of the wholesale market, published by the *Oil, Paint and Drug Reporter*, are the sources of the following averages. The quotations for both blood and ammonite were expressed in *units* of ammonia; these quotations have been recalculated on the assumption that a ton of these materials contains in each case fifteen *units*, or 300 pounds of potential ammonia.

WHOLESALE PRICE, PER TON, AT NEW YORK, DURING 1886.

MONTHS.	OF NITROGENOUS MATTER.								OF POTASH SALTS.					
	Nitrate of Soda.		Sulphate of Ammonia.		Azotine.		Dried Blood.		Muriate of Potash.		Kainite.		Double Sulphate of Potash and Magnesia.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Jan.......	$50 00	$48 00	$63 00	$60 00	$35 25	$34 50	$34 80	$34 05	$35 00	$33 50	$8 00	$7 25	$22 80	$21 60
Feb......	49 00	47 00	63 60	61 60	35 70	34 80	34 80	34 05	35 80	33 50	7 50	7 25	23 00	22 00
March..	51 80	49 60	65 60	64 60	36 60	35 85	37 20	36 45	40 00	33 50	7 93	7 37	24 80	22 60
April....	53 45	51 00	69 00	67 60	39 00	38 25	37 13	36 38	37 60	33 50	7 55	7 23	23 00	22 00
May.....	53 25	46 00	65 75	63 75	38 25	37 50	36 00	35 25	35 75	33 60	7 75	7 03	23 00	21 60
June....	50 60	42 00	60 80	59 40	36 45	35 70	34 80	34 05	34 20	33 10	7 33	6 90	22 40	21 00
July......	48 80	45 20	61 00	59 00	36 00	35 25	35 48	34 35	34 00	33 00	7 25	6 75	22 00	21 00
Aug......	45 80	42 20	60 60	59 00	36 00	35 25	35 32	34 58	34 00	33 00	7 25	6 90	22 00	21 00
Sept......	43 40	40 60	60 00	59 00	36 00	35 25	35 10	34 35	34 70	33 70	7 30	6 97	21 30	20 40
Oct.......	40 80	38 80	60 60	59 60	36 00	35 25	36 00	35 25	35 00	34 00	7 50	7 25	21 00	20 00
Nov......	40 00	38 00	61 20	60 00	36 00	35 25	35 25	34 50	34 75	33 75	7 50	7 13	21 00	20 00
Dec......	40 80	39 30	61 00	59 60	36 00	35 25	33 13	32 40	35 40	33 60	7 50	7 25	21 20	20 30

PHOSPHORIC ACID.

The wholesale prices of phosphoric acid seem to have remained unchanged throughout the year, the quotation for acid phosphate having invariably been from $12 to $15 per ton. The average analysis of eighteen samples examined at this Station is as follows:

Soluble Phosphoric Acid	9.57	per cent.
Reverted Phosphoric Acid	1.82	"
Insoluble Phosphoric Acid	3.71	"

At the average price of $13.50 per ton of acid phosphate, the wholesale prices per pound of phosphoric acid rule as follows:

	Cents.
Soluble	5.48
Reverted	5.48
Insoluble	1.37

NITROGEN AND POTASH.

Nitrate of Soda	Averages	16	per cent.	nitrogen.
Sulphate of Ammonia	"	20½	"	"
Dried Blood and Ammonite	"	12½	"	"
Muriate of Potash	"	50	"	potash.
Kainite	"	12½	"	"

Based upon these analyses the average wholesale prices per pound of nitrogen and potash were as follows:

EXPERIMENT STATION.
1888
UNIVERSITY OF ILLINOIS.

WHOLESALE PRICES, PER POUND, IN NEW YORK, DURING 1886.

1886. MONTHS.	WHOLESALE COST, PER POUND, OF NITROGEN IN FORM OF—								WHOLESALE COST, PER POUND, OF POTASH IN FORM OF—					
	Nitrate of Soda.		Sulphate of Ammonia		Azotine.		Dried Blood.		Muriate of Potash.		Kainite.		Double Sulphate of Potash and Magnesia.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.	cts.
January	15.6	15.0	15.4	14.6	14.3	13.9	14.1	13.8	3.5	3.4	3.2	2.9	4.6	4.3
February	15.3	14.7	15.5	15.0	14.5	14.1	14.1	13.8	3.6	3.4	3.0	2.9	4.6	4.4
March	16.2	15.5	16.0	15.8	14.8	14.5	15.1	14.8	4.0	3.4	3.2	2.9	5.0	4.5
April	16.7	15.9	16.8	16.5	15.8	15.5	15.0	14.7	3.8	3.4	3.0	2.9	4.6	4.4
May	16.6	14.4	16.0	15.5	15.5	15.2	14.6	14.3	3.6	3.4	3.1	2.8	4.6	4.3
June	15.8	13.1	14.8	14.5	14.8	14.5	14.1	13.8	3.4	3.3	2.9	2.8	4.5	4.2
July	15.3	14.1	14.9	14.4	14.6	14.2	14.4	13.9	3.4	3.3	2.9	2.7	4.4	4.2
August	14.3	13.2	14.8	14.4	14.6	14.2	14.3	14.0	3.4	3.3	2.9	2.8	4.4	4.2
September	13.6	12.7	14.6	14.4	14.6	14.2	14.2	13.9	3.5	3.4	2.9	2.8	4.3	4.1
October	12.8	12.1	14.8	14.5	14.6	14.2	14.6	14.2	3.5	3.4	3.0	2.9	4.2	4.0
November	12.8	11.9	14.9	14.6	14.6	14.2	14.2	14.0	3.5	3.4	3.0	2.9	4.2	4.0
December	12.8	12.3	14.9	14.5	14.6	14.2	13.4	13.1	3.5	3.4	3.0	2.9	4.2	4.1
Av. for the year	**14.3**		**15.1**		**14.6**		**14.2**		**3.5**		**2.9**		**4.3**	

According to the published reports, the wholesale prices of phosphoric acid have not varied during the year. The above table indicates that the wholesale prices of the various forms of nitrogen and potash have fluctuated somewhat, the highest point having been reached in April, the lowest in November and December, the range being from *eight* to *sixteen* per cent. Nitrate of soda offers the only exception to this rule, its wholesale price for November being *twenty-three* per cent. lower than that for May.

The following table has been prepared to offer an opportunity for studying the wholesale prices for the past three years. On comparing the last quarter in each year, it appears that nitrate of soda is now at its lowest point, nearly *ten* per cent. cheaper than at any previous date on this record; sulphate of ammonia, muriate of potash and kainite cost at present practically the same as in 1884 and 1885. The present price of dried blood, too, is identical with that of 1885, but azotine has advanced by *seven per cent.*

MONTHS.		AVERAGE WHOLESALE COST PER POUND OF NITROGEN IN FORM OF—												AVERAGE WHOLESALE COST PER POUND OF POTASH IN—								
		NITRATE OF SODA.			SULPHATE OF AMMONIA.			AZOTINE.			DRIED BLOOD.			MURIATE OF POTASH.			KAINITE.			DOUBLE SULPHATE OF POTASH AND MAGNESIA.		
		1884.	1885.	1886.	1884.	1885.	1886.	1884.	1885.	1886.	1884.	1885.	1886.	1884.	1885.	1886.	1884.	1885.	1886.	1884.	1885.	1886.
January…… February…… March……	Max……	14.6	14.0	15.7	16.0	15.9	15.6	13.9	13.4	14.5	13.5	12.9	14.4	3.4	3.6	3.7	3.3	3.5	3.1	……	……	4.7
	Min……	14.0	13.3	15.1	14.6	14.6	15.1	13.1	12.8	14.2	12.7	12.5	14.1	3.2	3.3	3.4	3.1	2.8	2.9	……	……	4.4
April…… May…… June……	Max……	14.1	14.0	16.4	15.2	15.9	15.9	13.8	13.6	15.4	14.1	14.1	14.6	3.5	3.7	3.6	3.3	4.1	3.0	……	……	4.6
	Min……	13.3	13.2	14.5	14.3	14.6	15.5	13.4	……	15.1	13.4	13.7	14.3	3.3	3.4	3.4	3.0	3.0	2.8	……	……	4.3
July…… August…… September……	Max……	14.3	14.7	14.4	14.9	15.4	14.8	13.5	13.6	14.6	13.5	13.8	14.3	3.5	3.5	3.4	3.0	2.9	2.9	……	……	4.4
	Min……	13.6	13.9	13.3	14.4	14.6	14.4	13.2	13.3	14.2	12.6	13.4	13.9	3.3	3.3	3.3	2.9	2.7	2.8	……	……	4.2
October…… November…… December……	Max……	14.1	15.8	12.7	15.7	15.2	14.9	13.0	13.7	14.6	12.9	14.1	14.1	3.4	3.5	3.5	2.6	3.2	3.0	……	……	4.2
	Min……	13.5	15.0	12.1	14.5	14.8	11.5	12.6	13.4	14.2	11.9	13.8	13.8	3.2	3.4	3.4	2.6	2.9	2.9	……	……	4.1
Yearly Averages.	Max……	14.3	14.6	14.8	15.5	15.6	15.6	13.6	13.6	14.8	13.5	13.7	14.4	3.5	3.6	3.6	3.1	3.4	3.0	……	……	4.5
	Min……	13.6	13.9	13.8	14.5	14.7	14.7	13.1	13.2	14.4	12.7	13.4	14.0	3.3	3.4	3.4	2.9	2.9	2.9	……	……	4.3

2.

THE AVERAGE RETAIL PRICES OF NITROGEN, PHOSPHORIC ACID AND POTASH IN CRUDE STOCK FROM WHICH COMPLETE FERTILIZERS ARE MADE.

From time to time, during the spring and summer, the Station's chemist visited, without warning, the principal factories from which this State's supplies of fertilizers are drawn. All material found was carefully sampled, and the retail cash prices were obtained by letter from the manufacturers. After an analysis of the samples, therefore, it was not difficult to calculate the retail prices per pound of the various forms of nitrogen, phosphoric acid and potash used in this trade.

The tables upon subsequent pages furnish in detail the information gained by this work, and afford data also for the following summary. For comparison, results secured in a similar manner in 1884 and 1885 are republished.

	1884.	1885.	1886.
	cts.	cts.	cts.
Cost per pound of Nitrogen from Nitrate of Soda	16.9	16.1	18.2
“ “ “ “ “ “ Sulphate of Ammonia	17.1	16.7	18.1
“ “ “ “ “ “ Dried Blood	18.3	15.5	20.0
“ “ “ “ “ “ Dried Fish	....	14.8	*16.6
“ “ “ “ “ “ Ammonite and Tankage	15.8	16.1	....
“ “ “ “ Soluble Phosphoric Acid from Bone Black	7.3	7.8	7.8
“ “ “ “ “ “ “ “ S. C. Rock	8.6	8.6	7.4
“ “ “ “ Reverted “ “ “ Bone Black	6.7	6.9	7.8
“ “ “ “ “ “ “ “ S. C. Rock	7.8	7.6	7.4
“ “ “ “ Insoluble “ “ “ Bone Black	2.9	1.7	1.9
“ “ “ “ “ “ “ “ S. C. Rock	1.9	1.9	1.9
“ “ “ “ Potash from High-Grade Sulphate	....	6.7	5.8
“ “ “ “ “ “ Double Sulph's of Potash and Magnesia	7.2	6.8	6.5
“ “ “ “ “ “ Kainite	4.5	4.5	4.2
“ “ “ “ “ “ Muriate	4.2	4.1	4.0

*This average also represents the retail cost of nitrogen in ammonite and castor pomace.

These averages are the *manufacturers' retail cash prices for the nitrogen, phosphoric acid and potash in the crude stock from which complete fertilizers are made.*

3.

THE COMPARISON BETWEEN THE AVERAGE WHOLESALE AND RETAIL PRICES OF NITROGEN, PHOSPHORIC ACID AND POTASH IN CRUDE STOCK.

The conclusions reached in Sections 1 and 2 are here tabulated. They represent the manufacturers' *wholesale* and *retail* prices for plant-food *in its best forms.* The percentages by which the retail prices exceed the wholesale, have been taken as the basis of the comparison.

	MANUFACTURERS' AVERAGES.		Average percentages by which the retail prices exceed the wholesale, 1886.	Average percentages by which the retail prices exceed the wholesale, 1885.
	Wholesale prices for 1886.	Retail prices for 1886.		
	cts.	cts.		
Nitrogen from Nitrate of Soda	14.3	18.2	27.3	12.5
" " Sulphate of Ammonia	15.1	18.1	19.9	9.86
" " Dried Blood	14.2	20.0	40.8	13.90
" " Dried Fish		16.6		
" " Ammonite	14.6	16.6	13.7	20.19
Soluble Phosphoric Acid from Bone Black		7.8		
" " " " S. C. Rock	5.48	7.4	35.0	51.24
Reverted " " " Bone Black		7.8		
" " " " S. C. Rock	5.48	7.4	35.0	52.00
Insoluble " " " Bone Black		1.9		
" " " " S. C. Rock	1.37	1.9	38.7	52.00
Potash from High-Grade Sulphate		5.8		
" " Double Sulphates of Potash and Magnesia	4.3	6.5	51.2	51.00
" " Kainite	2.9	4.2	44.8	40.62
" " Muriate	3.5	4.0	14.3	17.14

In 1885 manufacturers retailed nitrogenous matter at prices from ten to twenty per cent. in advance of the average wholesale quotations; in 1886, however, their retail prices for the same materials were decidedly advanced, and ranged from fourteen to forty per cent. higher than the corresponding wholesale rates.

Phosphoric acid has apparently felt the effects of competition, its price at retail being this year thirty-five per cent. higher than at wholesale; last year the difference in these prices was fifty-one per cent.

Practically, potash remains nearly uniform in price, retail rates last year exceeding wholesale in some cases by fourteen per cent. only, in other cases by fifty-one per cent.; the same report applies also to this year's market.

THE SOURCES OF THE NITROGEN, PHOSPHORIC ACID AND POTASH FOUND IN COMPLETE FERTILIZERS.

As has been already stated, the Chemist of this Station visits without warning nearly all of the factories in which this State's supplies of fertilizers are prepared. These visits are invariably made during the busiest season of the year, and an opportunity is thereby secured for inspecting and sampling crude stocks. In this manner reliable information is gained regarding the quality of the nitrogen, phosphoric acid and potash used by each manufacturer in his brands of complete manures.

NITROGENOUS MATERIALS.

In the following tables these materials have been classified as soluble and as insoluble in water. In the first class may be found the *nitrates* and *ammonia salts;* in the second, dried blood, dried fish, ammonite, tankage and other forms of organic nitrogen.

Difficulties were experienced in securing samples of dried blood. In some factories the foremen claimed that their stocks were for the moment exhausted, but that new cargoes were hourly expected. In other places tankage was offered as a substitute.

Regarding tankage, the firm of Armour & Co., of Chicago, in reply to an inquiry, furnished the following information:

The scraps and useless pieces of meat and bone are boiled and then subjected to hydraulic pressure, by which fat and water are removed. The cakes from the presses are then desiccated in revolving dryers, and afterwards ground. Some samples of the dried product analyze *four* per cent. ammonia and fifty to fifty-five per cent. bone phosphate of lime, and therefore are practically pure ground bone. Other samples analyze seven to eight per cent. of ammonia and from thirty to thirty-five per cent. bone phosphate of lime, indicating that considerable meat has been dried and ground with the bone.

As a rule, dealers have declined to give retail cash prices for tankage, claiming that a retail trade in it does not exist. The few quotations obtained indicate that it is a very cheap source of nitrogen, and therefore should be brought to the attention of consumers.

PHOSPHORIC ACID.

The superphosphates have been arranged with reference to the crude stock from which they are made; those from bone black and bone ash being in the first table, and those from South Carolina rock and similar mineral phosphates in the second.

An effort is now being made to increase the sales of so-called natural guanos in this State.

In some counties they are regarded with favor by consumers, and, consequently, their number increases from year to year. Five such samples are tabulated upon a subsequent page. Their sources are islands in the Caribbean sea, or in the Gulf of Mexico. This table also contains an analysis of phosphate meal from the Peine Thomas scoria, a product comparatively new in this country. This meal is a waste product from the steel works of Peine, in Germany. In rolling mills at this place a pig-iron rich in phosphorous is worked according to the Sidney Gilchrist Thomas patents. During this process the phosphorus is converted into phosphoric acid, which, combined with lime, is run out as slag; when the excess of caustic lime in this slag slakes a very finely divided product is secured, containing *twenty per cent.* of phosphoric acid.

Field experiments upon wheat and rye to determine the relative values of this scoria, as compared with that of several of the other insoluble phosphates in this table, are now in progress in different sections of this State under the immediate supervision of this Station.

POTASH SALTS.

The State law provides that in the analysis of fertilizers chemists shall determine only those forms of potash which dissolve in water; it ignores, therefore, greensand marl, and also certain forms of organic matter, both of which are sometimes used as sources of this element.

The "muriate," "kainite" and "double sulphate" are well-known salts from the German mines near Stassfurt. The two first mentioned are now frequently found in farmers' hands, but the high prices demanded for small lots at retail exclude the double sulphate from the trade.

A new product, known as the high-grade sulphate, has recently been introduced. It contains potash equivalent to ninety-five per cent. sulphate of potash, and, consequently, may prove very serviceable to manufacturers who wish to use nitrogenous matters or phosphates of low percentage composition in making up their standard fertilizers. Four samples of this salt are tabulated upon a subsequent page.

FORMS OF NITROGEN

Readily and Completely Soluble in Water.

NITRATE OF SODA

FURNISHING

Nitrogen in Form of Nitrates.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Nitrogen.	Cost of Nitrogen per lb. cts.	Cost of 2,000 lbs. of Nitrate of Soda.
1131	Mapes' Formula and Peruvian Guano Co.	16.12	16.6	*$53 50
1136	Lister Bros., Newark	15.80	18.2	57 50
1150	Geo. B. Forrester, New York	16.30	17.6	57 50
1156	H. J. Baker & Bro., New York	16.30	17.6	57 50
1171	Bowker Fertilizer Co., New York	16.29	19.9	65 00
1185	Williams, Clark & Co., New York	16.42	17.5	57 50
1210	M. L. Shoemaker & Co., Philadelphia	15.87	18.9	60 00
1221	Moro Phillips, Camden	16.42	....	....
1232	Sharpless & Carpenter, Philadelphia	15.80	19.0	60 00
1239	Baugh & Sons, Philadelphia	16.07	18.6	60 00
Average cost per pound of Nitrogen in Nitrate of Soda			18.2	....

SULPHATE OF AMMONIA

FURNISHING

Nitrogen in Form of Ammonia.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Nitrogen.	Cost of Nitrogen per lb. cts.	Cost of 2,000 lbs. of Sulphate of Ammonia.
1132	Mapes' Formula and Peruvian Guano Co.	20.27	16.0	*$65 00
1137	Lister Bros., Newark	20.76	17.5	72 50
1151	Geo. B. Forrester, New York	21.06	17.2	72 50
1157	H. J. Baker & Bro., New York	20.76	18.9	77 50
1165	C. Meyer, Jr., Maspeth, L. I.	20.08	18.1	72 50
1166	C. Meyer, Jr., Maspeth, L. I.	17.89	19.7	70 00
1172	Bowker Fertilizer Co., New York	20.65	18.2	75 00
1194	Williams, Clark & Co., New York	20.29	17.7	72 00
1200	E. Frank Coe, New York	20.06	....	....
1211	M. L. Shoemaker & Co., Philadelphia	20.37	17.2	70 00
1233	Sharpless & Carpenter, Philadelphia	20.44	19.7	80 00
1240	Baugh & Sons, Philadelphia	20.03	18.7	75 00
Average cost per pound of Nitrogen in Sulphate of Ammonia			18.1	....

*Delivered, in car load lots, at Moorestown.

FORMS OF NITROGEN INSOLUBLE IN WATER

FURNISHING

Nitrogen in Form of Organic Matter.

DRIED BLOOD.

Station No.	NAME AND ADDRESS OF DEALER.	Percentage of Nitrogen.	Cost of Nitrogen per lb.	Cost of 2,000 lbs. of Dried Blood.
			cts.	
1149	Mapes' F. and P. Guano Co.	10.11	**19.8**	$40 00
1175	Bowker Fertilizer Co	10.02	**21.2**	42 50
1186	Williams, Clark & Co	9.49	**19.0**	36 00
1139	Lister Bros	14.26	....	?
Average cost per pound of Nitrogen in Dried Blood			**20.0**	....

AMMONITE, FISH AND CASTOR POMACE.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage.		Cost Per Pound.		Cost of 2,000 lbs. of Fertilizer.
		Nitrogen.	Phosphoric Acid.	Nitrogen.	Phosphoric Acid.	
				cts.	cts.	
1212	M. L. Shoemaker's Ammonite B	12.08	4.39	**16.1**	7.0	$45 00
1227	U. S. Chemical Co., Ammonite B	12.17	1.56	**16.7**	7.0	42 50
1241	Baugh & Son's AA Nitrogen	10.50	3.68	**19.0**	7.0	45 00
1176	Bowker's Dried Ground Fish	9.12	7.33	**16.3**	7.0	40 00
1228	U. S. Chemical Co., Dried Ground Fish	8.61	6.81	**11.9**	7.0	30 00
1248	Garrison & Minch, Dried Ground Fish	8.43	7.13	**17.8**	7.0	40 00
1158	H. J. Baker & Bro., Castor Pomace	4.71	1.73	**18.6**	7.0	20 00
Average cost per pound of Nitrogen				**16.6**	....	....

TANKAGE AND SWIFT SURE GUANO.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage.		Cost Per Pound.		Cost of 2,000 lbs. of Fertilizer.
		Nitrogen.	Phosphoric Acid.	Nitrogen.	Phosphoric Acid.	
				cts.	cts.	
1138	Lister Bros., Tankage	7.88	8.00	....	....	....
1148	Mapes' F. and P. Guano Co., Tankage	6.55	14.26	....	....	....
1167	C. Meyer, Jr., Tankage	9.12	4.94	**12.1**	5.0	$28 00
1174	Bowker's Fertilizer Co., Tankage	8.55	8.20	....	....	....
1195	John Taylor & Co., Hog Tankage	6.11	14.65	....	....	....
1196	John Taylor & Co., Beef Tankage	3.35	19.97	....	....	....
1197	John Taylor & Co., Hog Tankage	4.90	18.91	....	....	....
1203	E. Frank Coe, Tankage	3.19	17.02	....	....	....
1213	M. L. Shoemaker & Co., Swift Sure Guano	7.95	11.98	**10.1**	5.0	28 00
1234	Sharpless & Carpenter, Tankage	6.14	14.49	....	....	....
1173	Bowker's Fertilizer Co., Hoof Meal	15.11	0.13	....	....	....

PLAIN SUPERPHOSPHATES

Furnishing Soluble, Reverted and Insoluble Phosphoric Acid.

MANUFACTURED FROM

BONE BLACK, BONE ASH, &c., &c.

Station number.	BRAND.	MANUFACTURER OR WHOLESALER.	SAMPLED BY.
1134	Bone Black Superphosphate....	Mapes' F. and P. Guano Co., New York.	H. I. Budd, Mt. Holly.
1143	Bone Black Superphosphate....	Lister Brothers, Newark.	Chemist of Station.
1155	Bone Black Superphosphate....	George B. Forrester, New York.	Chemist of Station.
1164	Bone Black Superphosphate....	H. J. Baker & Bro., New York.	Chemist of Station.
1170	Bone Black Superphosphate....	C. Meyer, Jr., Maspeth, L. I.	Chemist of Station.
1181	Bone Black Superphosphate....	Bowker Fertilizer Co., New York.	Chemist of Station.
1192	Bone Black Superphosphate....	Williams, Clark & Co., New York.	Chemist of Station.
1206	Bone Black Superphosphate....	E. F. Coe, New York.	Chemist of Station.
1214	Bone Ash Superphosphate.......	M. L. Shoemaker & Co., Philadelphia.	Chemist of Station.
1215	Bone Black Superphosphate....	M. L. Shoemaker & Co., Philadelphia.	Chemist of Station.
1243	Bone Black Superphosphate....	Baugh & Son, Philadelphia.	Chemist of Station.
1328	Bone Black Superphosphate....	Bowker Fertilizer Co., New York.	J. M. White, New Brunswick.
1351	Bone Black Superphosphate....	Preston Fertilizer Co., Greenpoint, L. I.	H. I. Budd, Mt. Holly.
1374	High Grade Superphosphate...	Mapes' F. and P. Guano Co., New York.	Chemist of Station.

MINERAL PHOSPHATES, GROUND, NOT DISSOLVED.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.
1127	Floats, Calcined........................	Tropic Guano Co., New York.	Chemist of Station.
1407	Carib Guano..............................	L. N. & J. S. Hopkins, Importers, Baltimore, Md.	I. W. Nicholson, Camden, N. J.
1414	Penguin Island Guano............	Charles Spear, Jr., Importer, New York.	J. M. White, New Brunswick, N. J.
1515	Orchilla Guano.........................	R. A. Wooldridge, Baltimore.	Theodore F. Baker, Bridgeton, N. J.
1596	Phosphate Meal........................	Paul Weidinger, New York.	Chemist of Station.
1605	Grand Cayman Island Guano..	N. B. Powter, New York.	Chemist of Station.

PLAIN SUPERPHOSPHATES

Furnishing Soluble, Reverted and Insoluble Phosphoric Acid.

MANUFACTURED FROM

BONE BLACK, BONE ASH, &c., &c.

Station number.	MANUFACTURER OR WHOLESALER.	Phosphoric Acid.				Cost Per Pound.		Cost of 2,000 lbs. of Fertilizer.
		Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	"Available."	Of "Available" Phosphoric Acid.	Of Insoluble Phosphoric Acid.	
						cts.	cts.	
1134	Mapes' F. and P. Guano Co...	14.82	2.41	trace.	17.23	7.50	....	*$26 50
1143	Lister Bros...........................	17.43	0.17	trace.	17.60	8.20	....	29 00
1155	Geo. B. Forrester..................	16.42	0.35	trace.	16.77	8.70	....	29 00
1164	H. J. Baker & Bro.................	17.32	0.63	trace.	17.95	8.10	....	29 00
1170	C. Meyer, Jr.........................	14.40	3.09	0.37	17.49	8.20	2.05	29 00
1192	Williams, Clark & Co............	14.59	3.20	0.35	17.79	6.70	1.68	24 00
1206	E. F. Coe..............................	14.40	3.08	1.72	17.48	....	....	....
1214	M. L. Shoemaker & Co.........	15.45	0.32	0.23	15.77	7.00	1.74	22 00
1215	M. L. Shoemaker & Co.........	14.30	0.81	0.83	15.11	7.20	1.80	22 00
1243	Baugh & Son........................	14.34	0.29	0.22	14.63	8.50	2.13	25 00
1328	Bowker Fertilizer Co............	14.69	0.41	0.20	15.11	7.60	1.90	23 00
1351	Prestons Fertilizer Co...........	16.20	0.64	0.25	16.84	....	....	....
1374	Mapes' F. and P. Guano Co...	27.76	5.20	1.54	32.96	8.30	2.06	55 00
Average cost per pound of Phos. Acid from Bone Black...						7.80	1.90	....

*Delivered in car-load lots at Moorestown.

MINERAL PHOSPHATES, GROUND, NOT DISSOLVED.

Station nnmber.		Phosphoric Acid.				
		Total.	Soluble in Ammonium Citrate at 40° C.	Insoluble in Ammonium Citrate at 40° C.	Soluble in Ammonium Citrate at 65° C.	Insoluble in Ammonium Citrate at 65° C.
1127	Connetable Island Floats................................	42.40	3.72	38.68	27.48	14.92
1407	Carib Guano..	18.92	1.41	17.51	....	....
1414	Penguin Island Guano....................................	21.30	....	....	....	....
1515	Orchilla Guano..	16.72	4.20	12.52	....	....
1596	Phosphate Meal from Peine Thomas Scoria.....	20.48	7.26	13.22	....	....
1605	Grand Cayman Island Guano..........................	25.91	2.80	23.11	....	....

PLAIN SUPERPHOSPHATES

Furnishing Soluble, Reverted and Insoluble Phosphoric Acid.

MANUFACTURED FROM

SOUTH CAROLINA ROCK AND OTHER MINERAL PHOSPHATES.

Station number.	BRAND.	MANUFACTURER OR WHOLESALER.	SAMPLED BY.
1133	Acid Phosphate	Mapes' F. and P. Guano Co., New York.	H. I. Budd, Mt. Holly.
1163	Packard's High Grade Superphosphate.	H. J. Baker & Bro., New York.	Chemist of Station.
1180	Packard's High Grade Superphosphate.	Bowker Fertilizer Co., New York.	Chemist of Station.
1182	Acid Phosphate	Bowker Fertilizer Co., New York.	Chemist of Station.
1193	Acid Phosphate	Williams, Clark & Co., New York.	Chemist of Station.
1198	Acid Phosphate	Lord & Polk, Philadelphia.	A. P. Arnold and L. Mortimer, Vineland
1205	Acid Phosphate	E. Frank Coe, New York.	Chemist of Station.
1216	Acid Phosphate	M. L. Shoemaker & Co., Philadelphia.	Chemist of Station.
1223	Acid Phosphate	Moro Phillips, Camden.	Chemist of Station.
1229	Philadelphia Standard	U. S. Chemical Co., Camden.	Chemist of Station.
1231	Acid Phosphate	N. J. Chemical Co., Camden.	Chemist of Station.
1238	Acid Phosphate	Sharpless & Carpenter, Philadelphia.	Chemist of Station.
1245	Acid Phosphate	Baugh & Son, Philadelphia.	Chemist of Station.
1375	Diamond Soluble Bone	Walton, Whann & Co., Wilmington.	J. H. Denise, Freehold.
1389	Acid Phosphate	Dambmann Bros. & Co., Baltimore.	J. M. White, New Brunswick.
1411	English Superphosphate	L. T. Derousse, Camden.	I. W. Nicholson, Camden.
1416	Acid Phosphate—New Process	J. J. Allen's Sons, Philadelphia.	H. I. Budd, Mt. Holly.
1485	Acid Phosphate	J. E. Tygert & Co., Philadelphia.	Theo. F. Baker, Bridgeton.

PLAIN SUPERPHOSPHATES

Furnishing Soluble, Reverted and Insoluble Phosphoric Acid.

MANUFACTURED FROM

SOUTH CAROLINA ROCK AND OTHER MINERAL PHOSPHATES.

Station number.	MANUFACTURER.	Phosphoric Acid.				Cost Per Pound.		Cost of 2,000 lbs. of Fertilizer.
		Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	"Available."	"Available" Phosphoric Acid.	Insoluble Phosphoric Acid.	
						cts.	cts.	
1133	Mapes' F. and P. Guano Co.	9.79	2.63	2.56	12.42	6.51	1.63	* $17 00
1163	H. J. Baker & Bro.	37.02	5.17	2.34	42.19	8.76	2.19	75 00
1180	Bowker Fertilizer Co.	42.53	2.84	0.45	45.37	7.96	1.99	72 50
1182	Bowker Fertilizer Co.	12.27	0.69	1.63	12.96	8.40	2.10	22 50
1193	Williams, Clark & Co.	9.70	0.94	4.41	10.64	7.00	1.75	16 00
1198	Lord & Polk	7.91	2.45	6.15	10.36	6.40	1.60	† 15 25
1205	E. Frank Coe	11.04	1.50	3.10	12.54	....	....	....
1216	M. L. Shoemaker & Co.	12.29	0.74	0.92	13.03	7.56	1.89	20 00
1223	Moro Phillips	9.31	2.24	3.84	11.55	....	....	....
1229	U. S. Chemical Co.	9.12	2.64	3.83	11.76	6.68	1.67	17.00
1231	New Jersey Chemical Co.	10.46	2.07	3.46	12.53	7.48	1.87	20 00
1238	Sharpless & Carpenter	7.95	1.55	8.29	9.50	6.92	1.73	16 00
1245	Baugh & Sons	7.01	2.52	7.05	9.53	6.64	1.66	15 00
1375	Walton, Whann & Co.	6.83	4.05	5.27	10.88	9.40	2.35	‡ 23 00
1389	Dambmann Bros. & Co.	10.01	1.21	2.98	11.22	7.52	1.88	18 00
1411	L. T. Derousse	12.33	0.57	1.15	12.90	5.68	1.42	15 00
1416	J. J. Allen's Sons	8.35	1.90	1.82	10.25	7.96	1.99	17 00
1485	J. E. Tygert & Co.	8.87	1.37	2.89	10.24	7.76	1.94	17 00
Average Cost per pound of Phos. Acid from S. C. Rock						7.41	1.85	....

* Delivered in car-load lots at Moorestown. † Delivered in car-load lots at Vineland.
‡ Retail price per ton at Freehold.

GERMAN POTASH SALTS.

HIGH GRADE

Sulphate and "Bi-Sulphate" of Potash.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Potash.	Cost of Potash per pound.	Cost of 2,000 pounds of the High Grade Sulphate.
			cts.	
1146	Mapes' High Grade Sulphate	51.30	....	....
1152	Forrester's "Bi-Sulphate of Potash"	35.54	6.0	$42 50
1189	Williams, Clark & Co., High Grade Sulphate	48.45	6.2	60 00
1220	Shoemaker's High Grade Sulphate	52.06	5.3	55 00
1226	Moro Phillips' "Bi-Sulphate of Potash"	34.68	....	....
Average cost per pound of Potash			5.8	....

MURIATE OF POTASH.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Potash.	Cost of Potash per pound.	Cost of 2,000 pounds of Muriate.
			cts.	
1135	Mapes' F. and P. Guano Co., New York City	52.47	3.91	*$41 00
1142	Lister Brothers, Newark	52.10	4.08	42 50
1154	George B. Forrester, New York City	52.40	4.06	42 50
1161	H. J. Baker & Bro., New York City	54.86	4.20	46 00
1169	C. Meyer, Jr., Maspeth, L. I	51.70	4.10	42 50
1183	Bowker Fertilizer Co., New York City	51.58	3.88	40 00
1188	Williams, Clark & Co., New York City	51.78	3.86	40 00
1199	Kimball & Prince, Vineland	51.02	3.95	40 27
1207	E. Frank Coe, New York City	55.24	....	....
1217	M. L. Shoemaker & Co., Philadelphia	54.26	3.69	40 00
1224	Moro Phillips, Camden	52.64	....	....
1230	U. S. Chemical Co., Camden	56.06	3.57	40 00
1235	Sharpless & Carpenter, Philadelphia	52.68	4.27	45 00
1246	Baugh & Son, Philadelphia	50.76	4.43	45 00
1247	Alex. Kerr, Bros. & Co., Philadelphia	52.16	3.55	37 00
1249	Garrison & Minch, Bridgeton	52.18	4.40	46 00

Average cost of Potash per pound in Muriate.............. 4 cents.

1372	Salzbergwerk, New Stassfurt, Germany	52.98	3.40	†36 00

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* Delivered in car-load lots at the Moorestown depot.

† Sold to the Rio Grand Sugar Company at $34 per ton, of eighty per cent. Muriate. Sample represents one hundred tons used upon this sorghum plantation during the spring of 1886.

KAINIT.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Potash.	Cost of Potash per pound.	Cost of 2,000 lbs. of Kainit.
			cts.	
1141	Lister Bros., Newark	12.81	3.9	$10 00
1147	Mapes' F. and P. Guano Co., New York City	12.61	4.8	12 00
1162	H. J. Baker & Bro., New York City	12.63	4.2	10 50
1184	Bowker Fertilizer Co., New York City.,	12.81	3.7	9 50
1191	Williams, Clark & Co., New York City	12.87	4.1	10 50
1208	E. Frank Coe, New York City	12.82	....	....
1218	M. L. Shoemaker & Co., Philadelphia	12.51	4.0	10 00
1225	Moro Phillips, Camden	12.74	....	....
1236	Sharpless & Carpenter, Philadelphia	11.86	4.2	10 00
1244	Baugh & Son, Philadelphia	12.36	4.0	10 00
1406	National Fertilizer Co., Bridgeport	12.36	5.7	*14 00
1424	Alex. Kerr, Bros. & Co., Philadelphia	12.46	3.8	9 50
Average cost of Potash per pound in Kainit			4.2	....

* Retail price per ton at Freehold.

DOUBLE SULPHATES OF POTASH AND MAGNESIA.

Station number.	NAME AND ADDRESS OF DEALER.	Percentage of Potash.	Cost of Potash per pound.	Cost of 2,000 lbs. of the Double Sulphate.
			cts.	
1140	Lister Bros., Newark	27.30	6.4	$35 00
1145	Mapes' F. and P. Guano Co., New York	24.89	7.0	35 00
1153	Geo. B. Forrester, New York	26.03	6.7	35 00
1159	H. J. Baker & Bro., New York	26.37	6.6	35 00
1190	Williams, Clark & Co., New York	26.38	6.1	32 00
1209	E. Frank Coe, New York	25.02	....	....
1219	M. L. Shoemaker & Co., Philadelphia	25.72	5.8	30 00
1168	C. Meyer, Jr., Maspeth, L. I.	25.32	6.9	35 00
Average cost per pound of Potash			6.5	....

THE GUARANTEED CHEMICAL COMPOSITION AND RELATIVE COMMERCIAL VALUES OF MERCHANTABLE FERTILIZERS.

An act to regulate the manufacture and sale of fertilizers.

[Laws of New Jersey for 1874, page 90.]

1. That every commercial fertilizer which shall be offered for sale in this state shall be accompanied by an analysis, stating the percentage therein of ammonia, or its equivalent of nitrogen; of potash, in any form or combination, soluble in distilled water; and of phosphoric acid in any form or combination; the portion of phosphoric acid soluble in distilled water; that portion soluble in a neutral solution of citrate of ammonia at a temperature not exceeding one hundred degrees Fahrenheit; and that portion of phosphoric acid not soluble in either of the above-named fluids, shall each be determined separately; and the material from which the phosphoric acid is obtained shall also be stated; a legible statement of such analysis shall accompany all packages or lots of over one hundred pounds sold, offered or exposed for sale.

5. That any person selling, offering or exposing for sale any commercial fertilizer without the analysis required by the first section of this act, or the act to which this act is a supplement, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense; *provided further*, that the provisions of this section, or the act to which this act is a supplement, shall not apply to any manure sold at a price not exceeding one-half a cent per pound, nor to any imported guanos.

Farmers believe that it is the duty of this Station:

1. To sample, officially, every brand of fertilizer which is offered for sale in this State.
2. To publish the official analysis of said brands in comparison with their manufacturers' guarantees.
3. To state the retail cash value of the plant-food present in each brand.
4. To publish the results in a manner which admits of a rapid and fair comparison of the commercial values of the different brands.

This interpretation of its duties is accepted by the Station's officers, and the trade in complete fertilizers in New Jersey is controlled from these standpoints as thoroughly as available resources will permit.

The details of the past year's work are as follows:

SAMPLING.

The aim has been to select, as inspectors, men who represent the intelligent and progressive element in the farming community, and who are known and respected both by consumers and producers of fertilizers. Complaints in regard to the sampling have, therefore, been seldom made. The names of the inspectors who have served during the past season, are as follows:

I. W. Nicholson	Camden.
H. I. Budd	Mount Holly.
T. F. Baker	Bridgeton.
J. M. White	New Brunswick.
J. H. Denise	Freehold.
Franklin Dye	Trenton.
J. J. Mitchell	Whippany.

Valuable service has also been rendered by Mr. A. W. Duryee, New Durham; by Mr. E. N. Millen, Deckertown, and by Mr. D. T. Pursel, New Village.

At the beginning of the season, each inspector was furnished with a sampling tube, blanks for describing samples, bottle labels, &c., together with printed instructions regarding their uses, and each inspector was requested to secure a sample of every brand of complete fertilizer which he could find in his district. As fast as samples were found they were shipped to New Brunswick, and there properly numbered and stored.

A copy of the instructions, under which all samples were taken, is as follows:

DIRECTIONS TO BE OBSERVED IN SAMPLING FERTILIZERS.

Inspectors may sample fertilizers found either—

First—Upon farms;
Second—In dealers' storehouses; or,
Third—In manufactories.

The Station prefers that samples should be drawn either upon farms or in dealers' storehouses.

In sampling fertilizers found upon farms, Inspectors should ascertain—

First—That the farmer has received these fertilizers *during the present season;*

Second—That they were received in good condition, and have since been so stored that a noticeable gain or loss of moisture has been prevented.

In no case should farm samples be taken from stock of a past season or from stock which is or has been carelessly stored.

In sampling from *dealers' storehouses*, Inspectors should also ascertain whether the fertilizers are of old (last season's) or of new stock. Preference should always be given to the present season's goods. Circumstances may, however, make it advisable to sample old stock; in such cases, this fact should be distinctly stated by the Inspector, in his report to the Station's Director.

If for any reason it is found to be necessary to draw samples at factories, Inspectors should decline—

First—To sample from piles of fertilizers;

Second—To sample from bags which are not distinctly marked with the brand, the manufacturer's name and the guaranteed analysis.

If fertilizers are found stored in piles only, Inspectors should cause six or more bags to be filled from different portions of the piles; from these bags the samples may be drawn in the usual manner.

SAMPLING.

Whenever the mechanical condition will allow, samples should be drawn by means of the *sampling tube.*

This tube is formed to a sharp point at one end, and can be forced to the bottom of a bag or barrel. A slot extending nearly its entire length can then be opened and the tube allowed to fill with the fertilizer. When the slot is closed and the tube withdrawn, it will contain a fair sample of any given package.

It is not desirable to sample lots of less than one-half ton of any one brand. In such lots portions may be taken from each bag; in larger lots each fifth or tenth bag may be opened. The several portions representing the same brand should then be carefully mixed and a quart fruit-jar filled, securely closed and marked with labels furnished by the Station.

As soon as a sample has been taken, and *invariably* before bags of another brand have been opened, the Inspector should carefully fill out the blank describing samples.

He should copy *from the bags*—

First—The brand;

Second—The name of the manufacturer;

Third—The guaranteed analysis.

Any other information desired can be sought from the owner of the fertilizer.

Each sample bottle should be carefully wrapped in heavy paper, and packed for transportation in a wooden box, properly closed. This box should be forwarded by express, directed to

THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION,
GEO. H. COOK, *Director*,
New Brunswick, N. J.

LABORATORY METHODS.

Early in the spring, every fertilizer manufacturer whose address is known at this Station was requested to give the names and guaranteed analyses of the brands which he intended to place upon the New Jersey market during the season of 1886. In nine cases out of ten, this information was furnished promptly, but in several instances the circular was not answered, and in one case the answer was a positive refusal.

The names of the brands and their guaranteed analyses, as furnished by their manufacturers, were entered in an appropriate book, a copy of one page of which is here published for illustration, the manufacturer's name being omitted and letters being substituted for the names of his brands:

		GUARANTEED ANALYSIS.							SAMPLED BY.					
Manufacturer.	Brand.	Ammonia.	Soluble Phos. Acid.	Reverted Phos. Acid.	Insoluble Phos. Acid.	Available Phos. Acid.	Total Phos. Acid.	Potash.	I. W. Nicholson.	H. I. Budd.	J. M. White.	T. F. Baker.	J. H. Denise.	Franklin Dye.
....	A..........	4½–5	......	......	......	......	8–10	6–8	1296	1334	1323	1261	**1317**	1362
....	B..........	4½–5	......	......	......	......	10–12	6–7	....	**1335**	1325	1489	1432	....
....	C..........	5½–6½	......	......	......	......	6–8	8–10	....	....	**1322**	....	....	....
....	D..........	2–3	......	......	......	......	7–9	11–12	....	....	....	....	**1431**	....
....	E..........	6–8	......	......	......	......	7–9	6–8	....	....	....	**1263**	1430	....
....	F..........	3–4	......	......	......	......	12–16	2½–3½	1295	1333	1324	1262	1396	**1363**
....	G..........	4–5	......	......	......	......	10–12	4–5	**1297**	....	1391	....	....	1445
....	H..........	2½–3	......	......	......	......	11–13	2½–3	....	....	....	....	....	**1444**
....	I..........	1½–2	......	......	......	......	12–14	1½–2	....	....	**1466**	....	....	....

The number which was affixed to each sample immediately upon its receipt at the laboratory, was also entered in this book, opposite the guaranteed analysis of the brand which it represented, and directly beneath the name of the inspector by whom this sample was taken.

From the above copy, it will be evident that brands lettered A and F were widely distributed, every inspector having found them for sale in his district. It will also be noticed that one number only, opposite each brand, has been printed in black-faced type. This indicates the particular sample of that brand which was selected for analysis. One such entry, at least, is found under each inspector's name, showing that the analyses which represent this manufacturer were made upon samples drawn from six widely-different localities.

This detailed description of the sampling and of the laboratory methods is here published for the benefit of thoughtless or badly-informed traveling salesmen, who sometimes insinuate that their business rivals place specially-prepared lots of fertilizers where they will be found by unsuspecting inspectors, and that, consequently, these rivals have succeeded in securing favorable reports upon samples which do not represent their average product. No importance is attached to such charges by those who are familiar with the details of this work.

2.

THE STATION'S ANALYSES OF BRANDS, COMPARED WITH THEIR MANUFACTURERS' GUARANTEES.

A State law provides definitely as to the manner in which several of the necessary chemical determinations shall be made. This law is rigorously obeyed in the Station's laboratory, but in cases where latitude is allowed the analysts, the methods recognized by the Association of American Chemists have been adopted with slight modifications. The laboratory rules demand that all determinations shall be made in duplicate, that duplicates shall not be made either upon the same solutions or upon the same day, and that whenever it is possible duplicates shall be made by two radically different methods.

In all cases the Station's analyses of brands are compared with their manufacturers' guarantees, prominence being given to the comparison by the use of black-faced type. Out of one hundred and forty-six samples examined this season, eighty-two contain more nitrogen, more available phosphoric acid, and more potash, than their manufacturers claim, while six fall below their guarantees in all respects. Fifty-eight per cent., therefore, of the brands used in New Jersey this season were better than their manufacturers promised, while four per cent. were in all respects below grade. These percentage results are identical with those of last year.

Of the remaining samples twenty-four contain less nitrogen, thirty-one contain less available phosphoric acid, and thirty-four contain less soluble potash, than their guarantees require. In many cases the deficiency is hardly appreciable when expressed in dollars and cents ; in several cases it is more than counter-balanced by an excessive amount of some other valuable ingredient, indicating irregularity in making the mixture ; and in no case do the indications point to deliberate fraud. While, therefore, the condition of the fertilizer trade in New Jersey is still open to marked improvements, it is evident that it now compares favorably with that of any other State.

3.

THE RETAIL CASH VALUE OF THE PLANT–FOOD FOUND IN EACH BRAND.

In order that the results of the chemical analyses may be turned to practical use, it has been customary for many years for Stations to publish a commercial valuation for each brand of fertilizer. This necessitates the adoption of a price list, giving the cost per pound of nitrogen, phosphoric acid and potash, in the various forms in which these elements appear upon the market.

SCHEDULE OF TRADE VALUES ADOPTED BY EXPERIMENT STATIONS FOR THE SEASON OF 1886.

At a meeting of Stations' Directors and Chemists, the following schedule was arranged for use in Connecticut, Massachusetts and New Jersey during the season of 1886.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	Cents per pound.	
	1885.	1886.
Nitrogen in Ammonia Salts	18	18½
" " Nitrates	18	18½
" " Dried and fine ground fish	18	17
Organic Nitrogen in guano, dried and fine ground blood and meat	18	17
" " " cotton seed and linseed meal and in castor pomace	18	17
" " " fine ground bone	18	17
" " " fine medium bone	16	15
" " " medium bone	14	13
" " " coarse medium bone	12	11
" " " coarse bone, horn shavings, hair and fish scrap	10	9
Phosphoric Acid, soluble in water	9	8
" " " " ammonium citrate*	8	8
" " insoluble in dry, fine ground fish and in fine bone	6	7
" " " " fine medium bone	5½	6
" " " " medium bone	5	5
" " " " coarse medium bone	4½	4
" " " " coarse bone	4	3
" " " " fine ground rock phosphate,	2	2
Potash as High Grade Sulphate	7¼	5½
" " Kainite	4¼	4¼
" " Muriate	4¼	4¼

Station valuations are intended to represent the retail cash cost of the nitrogen, phosphoric acid and potash, *before the crude materials containing these elements have been mixed with each other to form a complete fertilizer.*

These valuations, therefore, are not intended to cover the expenses of mixing, bagging and transporting fertilizers from the factory to the farms. Such expenses depend upon the location of the works, the knowledge and facilities of the manufacturer, and the skill of his employes—conditions which cannot easily be estimated in dollars and cents. If, for example, the Station estimates the value of a given brand at $40 per ton, it means that for $40 a farmer can buy enough *unmixed material* to furnish the amount of nitrogen, phosphoric acid and potash shown by analysis to be present in that brand. If the farmer wants to learn how much this brand should cost him when ready for the drill, he must add to the $40 the expenses of mixing the crude materials with each other, packing the mixture into bags and freighting it to his farm.

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* The solubility of phosphates, in ammonium citrate solutions, is seriously affected by heat. An act of the Legislature (see Laws of New Jersey, 1874, page 90,) provides that in this determination the temperature used shall not exceed 100° Fah.; in Connecticut and Massachusetts 150° Fah. has been adopted. The higher the temperature the larger will be the percentage of phosphoric acid dissolved by ammonium citrate solutions, and the larger the amount of this so-called "reverted" phosphoric acid in a ton of superphosphate the lower will be the price per pound of said acid. Consequently the Stations' valuation of phosphoric acid, soluble in ammonium citrate, has been fixed at *seven and one-half cents per pound* for Connecticut and Massachusetts, and at *eight cents per pound* for New Jersey.

Before this schedule was used by this Station its accuracy was subjected to the following severe test: one hundred and twenty samples of crude material, including all of the best sources of plant-food, were collected, analyzed and the retail cost of their nitrogen, phosphoric acid and potash accurately determined. The schedule secured in the above manner, of *manufacturers' average retail cash prices* for plant-food in fertilizer supplies, has already been considered in detail in this report. In comparison with the Station's schedule it appears as follows:

COMPARISON BETWEEN STATION'S SCHEDULE AND MANUFACTURERS' AVERAGE RETAIL PRICES OF PLANT-FOOD IN FERTILIZER SUPPLIES.

	MANUFACTURERS' AVERAGE.		Station's schedule of prices for 1886.
	Retail prices for 1885.	Retail prices for 1886.	
	cts.	cts.	cts.
Cost per pound of Nitrogen from Nitrate of Soda	16.1	18.2	18.5
“ “ “ “ “ “ Sulphate of Ammonia	16.7	18.1	18.5
“ “ “ “ “ “ Dried Blood	15.5	20.0	17.0
“ “ “ “ “ “ Dried Fish	14.8	16.6	17.0
“ “ “ “ “ “ Ammonite	16.1	16.6	17.0
“ “ “ “ Soluble Phosphoric Acid from Bone Black	7.8	7.8	8.0
“ “ “ “ “ “ “ “ S. C. Rock	8.6	7.4	8.0
“ “ “ “ Reverted “ “ “ Bone Black	6.9	7.8	8.0
“ “ “ “ “ “ “ “ S. C. Rock	7.6	7.4	8.0
“ “ “ “ Insoluble “ “ “ Bone Black	1.7	1.9	2.0
“ “ “ “ “ “ “ “ S. C. Rock	1.9	1.9	2.0
“ “ “ “ Potash from High Grade Sulphate	6.7	5.8	5.5
“ “ “ “ “ “ Double Sulphate of Potash and Magnesia	6.8	6.5	5.5
“ “ “ “ “ “ Kainite	4.5	4.2	4.25
“ “ “ “ “ “ Muriate	4.1	4.0	4.25

In the Station's schedule the prices, in thirteen cases, approximate very closely the average rates charged by manufacturers; in two cases, however, noticeable differences occur. The Station's valuations for nitrogen in *dried blood*, and for the potash in the *double sulphate of potash and magnesia* are comparatively low. As regards dried blood this result was unexpected, as nothing in the wholesale market necessitated the advance. No retail trade exists in the double sulphate of potash; its retail quotations, therefore, indicate what dealers have charged, not what consumers have paid for it; its retail prices average more than fifty per cent. higher than its wholesale quotations.

This schedule has been used in calculating the retail cash value of—

150 samples of Complete Fertilizers.
19 samples of Ground Bone.
5 samples of Dissolved Bone.
3 samples of Bone and Potash.

The analysis and valuation of each sample may be found upon subsequent pages.

PUBLICATION.

When results of importance have been secured, they are published in bulletin form, and six thousand copies are circulated among the farmers and dealers of this State. Copies are also mailed to all of the State newspapers, and to all manufacturers whose brands have been inspected; but the custom observed in several States, of submitting to a manufacturer, for his approval or criticism, the official analyses of his brands previous to their publication, has not been adopted by this Station.

These bulletins contain the analyses in detail, the estimated value of the plant-food in each brand, and its retail cash price per ton at its manufacturer's depot. These prices have been easily obtained every season until the last, when in spite of unusual efforts such prices could not be secured for more than one-half of the brands analyzed.

COMPLETE FERTILIZERS.

List of Manufacturers Whose Brands Have Been Sampled and Analyzed this Year.

Mapes' F. and P. Guano Co.	158 Front Street, New York City.
Bowker Fertilizer Co.	27 Beaver Street, New York City.
Stearns & Co.	181 Front Street, New York City.
Bradley Fertilizer Co.	Boston, Mass.
William T. Allen	Lawrence Station, N. J.
Crocker Fertilizer Co.	60 Pearl Street, Buffalo, N. Y.
J. J. Allen's Sons	124 South Delaware Avenue, Philadelphia, Pa.
Granger Fertilizer Co.	Philadelphia, Pa.
A. Mitchell	Linden, N. J.
American Oil and Fertilizer Co.	Greenwich, N. J.
Equitable Fertilizer Co.	Baltimore, Md.
Groves & Dagett	Wilmington, Del.
Garrison & Minch	Bridgeton, N. J.
John Reed	33 Broadway, New York City.
Quaker City Manufacturing Co.	Philadelphia, Pa.
Arthur L. Sardy	10 Burling Slip, New York City.
H. J. Baker & Bro.	215 Pearl Street, New York City.
H. Doughten	Moorestown, N. J.
Clark's Cove Guano Co.	26 Burling Slip, New York City.
Theo. Glaser	Linden, N. J.
Ebeling Bros.	Clifford Street, Newark, N. J.
E. Frank Coe	16 Burling Slip, New York City.
Powell, Morse & Co.	Hoffman's Wharf, Va.
Lord & Polk	Odessa, Del.
T. Clancy	New Brunswick, N. J.
Pacific Guano Co.	State Street, Boston, Mass.
Newton & Ludlam	182 Front Street, New York City.
J. E. Tygert & Co.	42 South Delaware Avenue, Philadelphia, Pa.
John Taylor & Co.	Trenton, N. J.
Dambmann Bros.	13 German Street, Baltimore, Md.
Read & Co.	88 Wall Street, New York City.
Williams, Clark & Co.	101 Pearl Street, New York City.
Wenderoth & Son	1124 Cooper Street, Camden, N. J.
Sharpless & Carpenter	114 South Delaware Avenue, Philadelphia, Pa.
I. P. Thomas	Cheyney, Pa.
N. J. Chemical Co.	129 South Front Street, Philadelphia, Pa.
U. S. Chemical Co.	Camden, N. J.
H. B. Griffin	70 Cortlandt Street, New York City.
Moro Phillips	Philadelphia, Pa.
Preston Fertilizer Co.	Greenpoint, N. Y.
M. L. Shoemaker & Co.	Venango Street and Delaware Avenue, Philadelphia, Pa.
J. P. White's Sons	41 Peck Slip, New York City.
Lister Bros.	Newark, N. J.
Peninsular Fertilizer Co.	Smyrna, Del.
J. C. Gaskill	Birmingham, N. J.
Depue, Son & Co.	Belvidere, N. J.
Excelsior Fertilizer Co.	628 West Thirtieth, New York City.
George B. Forrester	169 Front Street, New York City
John I. Smith	Trenton, N. J.
C. Meyer, Jr.	Maspeth, N. Y.
Walton, Whann & Co.	Wilmington, Del.
National Fertilizer Co.	Bridgeport, Conn.

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1263	Mapes' Light Soil	Mapes' F. and P. Guano Co., 158 Front street, New York City.	T. F. Baker, Bridgeton.	1263
1297	Manure for General Use	" " " " " " " " "	I. W. Nicholson, Camden.	1297
1317	" " Potatoes	" " " " " " " " "	J. H. Denise, Freehold.	1317
1322	" " Cauliflower and Cabbage	" " " " " " " " "	J. M. White, New Brunswick.	1322
1335	" " Corn	" " " " " " " " "	H. I. Budd, Mount Holly.	1335
1363	Complete Manure, "A" Brand	" " " " " " " " "	Franklin Dye, Trenton.	1363
1431	Manure for Fruit and Vine	" " " " " " " " "	J. A. Denise, Freehold.	1431
1444	Nitrogenized Superphosphate	" " " " " " " " "	Franklin Dye, Trenton.	1444
1466	Ammoniated Dissolved Bone with Potash	" " " " " " " " "	J. M. White, New Brunswick.	1466
1266	Hill and Drill	Bowker Fertilizer Co., 27 Beaver street, New York City.	T. F. Baker, Bridgeton.	1266
1346	Fish and Potash	" " " " " " " " "	H. I. Budd, Mount Holly.	1346
1397	Dissolved Bone	" " " " " " " " "	J. H. Denise, Freehold.	1397
1410	Stockbridge Potato Manure	" " " " " " " " "	I. W. Nicholson, Camden.	1410
1433	Ammoniated Bone Phosphate	" " " " " " " " "	J. H. Denise, Freehold.	1433
1448	Ammoniated Superphosphate	" " " " " " " " "	J. M. White, New Brunswick.	1448
1567	Stockbridge Manure for Corn	" " " " " " " " "	J. J. Mitchell, Whippany.	1567

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
												Available.							
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.				
1263	Mapes' Light Soil	0.76	2.56	1.97	5.29	4.94	4.03	3.90	2.44	10.37	7.00	7.93	....	6.56	6.00	6.96	38.71	48.00	1263
1297	“ Manure for General Use	0.84	1.42	1.69	3.45	3.30	6.30	5.43	1.67	13.40	10.00	11.73	....	4.38	4.00	3.05	35.79	41.00	1297
1317	“ “ “ Potatoes	0.78	1.71	1.39	3.88	3.71	5.15	4.66	2.08	11.89	8.00	9.81	....	6.77	6.00	0.62	38.13	46.00	1317
1322	“ “ “ Caulifl'er & Cabbage	0.51	2.24	2.18	4.93	4.53	3.92	4.15	1.51	9.58	6.00	8.07	....	8.21	8.00	7.97	38.38	43.00	1322
1335	“ “ “ Corn	0.55	1.30	2.40	4.25	3.71	7.20	4.64	1.32	13.16	10.00	11.84	....	6.22	6.00	5.53	40.03	44.00	1335
1363	“ Complete Manure, “A” Brand	0.53	0.56	1.95	3.04	2.47	7.04	4.98	2.02	14.04	12.00	12.02	10.00	3.04	2.50	4.21	33.68	38.00	1363
1431	“ Manure for Fruit and Vine	0.45	0.69	1.47	2.61	1.65	4.93	3.22	1.00	9.15	7.00	8.15	....	10.40	11.00	0.61	34.09	40.00	1431
1444	“ Nitrogenized Superphosphate	0.43	0.15	2.21	2.79	2.06	8.08	4.39	2.76	15.23	11.00	12.47	9.00	2.91	2.50	2.67	33.75	35.00	1444
1446	“ Am. Dissolved Bone with Potash	......	0.21	1.01	1.22	1.23	8.70	3.42	0.90	13.02	12.00	12.12	10.00	2.45	1.50	5.21	26.22	30.00	1466
1266	Bowker's Hill and Drill	......	0.11	2.21	2.32	2.50	7.02	1.26	3.32	11.60	11.00	8.28	....	2.00	1.08	2.18	24.86	....	1266
1346	“ Fish and Potash	......	0.11	2.26	2.37	2.25	3.78	2.37	1.47	7.62	8.00	6.15	....	4.48	4.00	10.42	22.62	....	1346
1397	“ Dissolved Bone	......	0.10	1.54	1.64	1.65	10.16	0.83	2.09	13.08	10.00	10.99	....	1.17	1.10	0.46	25.59	....	1397
1410	“ Stockbridge Potato Manure	......	1.90	1.48	3.38	3.25	9.33	1.70	0.84	11.87	....	11.03	8.00	7.94	7.00	8.82	36.96	....	1410
1433	“ Ammoniated Bone Phosphate	......	0.18	0.90	1.08	1.65	8.27	0.57	2.85	11.69	7.00	8.84	....	3.08	2.08	1.23	22.55	....	1433
1448	“ “ Superphosphate	......	0.09	1.15	1.24	0.82	9.85	0.66	1.78	12.29	11.00	10.51	10.00	2.13	1.10	2.89	23.94	....	1448
1567	“ Stockbridge Manure for Corn	......	1.26	1.95	3.21	3.28	11.25	0.69	1.81	13.75	7.00	11.94	6.00	4.45	4.00	5.20	35.16	....	1567

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1272	Eagle	Stearns & Co., 181 Front street, New York City.	J. H. Denise, Freehold.	1272
1588	Ammoniated Bone	“ “ “ “ “ “ “ “	A. W. Duryee, New Durham.	1588
1273	Bradley's Complete Manure for Fruit Trees	Bradley Fertilizer Co., Boston, Mass.	J. H. Denise, Freehold.	1273
1274	“ Superphosphate of Lime	“ “ “ “ “	“ “ “	1274
1587	Potato and Vegetable Manure	“ “ “ “ “	“ “ “	1587
1353	Complete Phosphate	William T. Allen, Lawrence Station, N. J.	Franklin Dye, Trenton.	1353
1354	Special Fertilizer	“ “ “ “ “	“ “ “	1354
1355	Potato and Truck Manure	“ “ “ “ “	“ “ “	1355
1379	Queen City Phosphate	Crocker Buffalo Fertilizer and Chemical Works, N. Y.	J. H. Denise, Freehold.	1379
1523	Buffalo Ammoniated Bone Superphosphate	“ “ “ “ “ “ “	J. J. Mitchell, Whippany.	1523
1543	Vegetable Bone Superphosphate	“ “ “ “ “ “ “	“ “ “	1543
1546	Potato, Hop and Tobacco Fertilizer	“ “ “ “ “ “ “	“ “ “	1546
1400	Ten Per Cent. Guano	J. J. Allen's Sons, Philadelphia, Pa.	J. H. Denise, Freehold.	1400
1510	Nitro-Phosphate	“ “ “ “	T. F. Baker, Bridgeton.	1510
1511	Marine Guano	“ “ “ “	“ “ “	1511
1512	Popular Phosphate	“ “ “ “	“ “ “	1512

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
1272	Stearns & Co.'s Eagle Brand............	......	0.15	1.42	1.57	1.64	1.77	1.34	0.55	3.64	5.00	3.11	3.26	2.19	....	5.03	12.55	....	1272
1588	“ “ Ammoniated Bone.....	......	0.12	2.52	2.64	2.25	5.57	2.70	2.61	10.88	9.00	8.27	....	4.03	2.00	6.14	27.24	....	1588
1273	Bradley's Complete, for Fruit Trees...	0.45	0.10	2.47	3.02	2.05	4.21	2.06	1.91	8.18	10.00	6.27	....	5.98	5.40	3.20	27.14	42.50	1273
1274	“ Superphosphate of Lime.....	......	0.47	2.63	3.10	2.46	8.25	0.90	2.91	12.06	10.00	9.15	8.00	2.47	2.00	2.55	29.18	38.00	1274
1587	“ Potato & Vegetable Manure.	......	0.50	3.25	3.75	3.69	10.83	......	trace.	10.83	9.00	10.83	8.00	6.65	6.00	6.26	35.88	42.50	1587
1353	Wm. T. Allen's Complete Phosphate...	......	0.19	1.57	1.76	2.46	8.06	1.61	1.98	11.65	12.00	9.67	10.00	1.64	2.00	4.70	24.10	....	1353
1354	“ “ Special Fertilizer........	......	0.14	1.59	1.73	1.64	4.36	1.30	4.77	10.43	....	5.66	7.00	1.76	2.00	5.25	19.35	....	1354
1355	“ “ Potato & Truck Man're	......	1.23	2.28	3.51	3.25	6.72	0.40	1.20	8.32	10.00	7.12	7.00	7.36	7.00	8.81	30.67	42.00	1355
1379	Crocker's Queen City Phosphate........	......	0.09	1.92	2.01	1.64	7.01	0.68	2.13	9.82	9.00	7.69	8.00	1.69	1.00	1.48	21.89	....	1379
1523	“ Buffalo Am. Bone Superph..	... ..	0.07	3.68	3.75	2.87	8.16	0.99	1.90	11.05	9.00	9.15	8.00	1.78	1.00	1.61	32.29	....	1523
1543	“ Vegetable Bone Superphos..	......	0.11	5.04	5.15	4.92	4.61	1.65	0.42	6.68	7.00	6.26	6.00	5.12	6.00	4.81	32.17	....	1543
1546	“ Potato, Hop & Tobacco Fert.	......	0.08	2.35	2.43	2.05	8.39	1.65	1.53	11.57	9.00	10.04	8.00	3.81	3.00	3.76	28.51	....	1546
1400	J. J. Allen's Sons' Ten Per Cent. Guano.	......	6.54	2.34	8.88	8.20	3.68	1.00	3.37	8.05	6.00	4.68	....	1.95	2.50	2.54	43.33	....	1400
1510	“ “ Nitro-Phosphate	......	0.88	1.14	2.02	1.23	4.84	1.64	7.34	13.82	....	6.48	9.00	2.25	2.50	2.45	23.81	....	1510
1511	“ “ Marine Guano	......	1.88	2.20	4.08	3.69	5.12	1.38	5.70	12.20	....	6.50	6.00	2.56	2.00	2.50	30.44	....	1511
1512	“ “ Popular Phosphate...	......	0.13	0.67	0.80	0.61	1.48	4.88	6.62	12.98	....	6.36	6.00	1.85	2.50	5.47	18.48	....	1512

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1409	Granger Fertilizer	Granger Fertilizer Co., Philadelphia, Pa.	I. W. Nicholson, Camden.	1409
1440	Complete Manure	A. Mitchell, Tremley Point, Staten Island, N. Y.	J. H. Denise, Freehold.	1440
1497	Bay Side Fertilizer	American Oil and Fertilizer Co., Greenwich, N. J.	T. F. Baker, Bridgeton.	1497
1499	Potato Compound	Equitable Fertilizer Co., Baltimore, Md.	" " "	1499
1500	Special Esmeralda Guano	" " " "	" " "	1500
1502	Prime " "	" " " "	" " "	1502
1250	Rose Bone Fertilizer	" " " "	H. I. Budd, Mt. Holly.	1250
1251	Selected Esmeralda	" " " "	" " "	1251
1493	Raw Bone Superphosphate, stock of 1885	Groves & Dagett, Wilmington, Del.	T. F. Baker, Bridgeton.	1493
1517	Bone, Fish and Potash	Garrison & Minch, Bridgeton, N. J.	" " "	1517
1269	Pride of Cumberland	" " " "	" " "	1269
1561	Delta	John Reed, 33 Broadway, N. Y.	E. N. Millen, Deckertown, N. J.	1561
1304	Lobos Guano		I. W. Nicholson, Camden.	1304
1347	Quaker City Poudrette	Quaker City Manufacturing Co., Philadelphia, Pa.	H. I. Budd, Mt. Holly.	1347
1408	No. 1 Peruvian Guano		I. W. Nicholson, Camden.	1408
1479	Phospho Peruvian Guano	Arthur L. Sardy, 10 Burling Slip, N. Y.	J. M. White, New Brunswick.	1479

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.					
												Available.							
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
1409	Granger Fertilizer..................................	tra.	0.05	2.03	2.08	2.06	3.80	3.20	3.05	10.05	....	7.00	9.00	1.68	2.50	2.12	21.55	....	1409
1440	Mitchell's Complete Manure..................	......	0.92	1.31	2.23	2.88	7.30	0.96	2.29	10.55	6.00	8.26	....	4.19	3.80	4.87	26.00	....	1440
1497	American Oil and Fert. Co.'s Bay Side...	......	0.12	1.64	1.76	1.64	3.67	1.64	2.98	8.29	9.00	5.31	6.00	2.03	1.00	5.36	18.03	....	1497
1499	Equitable Co.'s Potato Compound..........	......	1.37	1.73	3.10	2.46	4.51	5.08	5,12	14.71	8.00	9.59	6.00	8.25	8.00	3.59	37.24	....	1499
1500	" " Spec. Esmeralda Guano.	0.72	0.37	0.79	1.88	1.84	0.26	3.90	10.98	15.14	15.00	4.16	6.00	2.82	2.00	5.00	22.37	....	1500
1502	" " Prime " "	......	0.51	1.07	1.58	1.23	5.39	5.53	8.38	19.30	15.00	10.92	6.00	2.72	1.50	5.45	30.34	....	1502
1250	" " Rose Bone Fertilizer......	......	0.04	0.28	0.32	0.32	4.60	3 59	5.05	13.24	10.50	8.19	9.50	2.47	2.00	4.06	19.33	....	1250
1251	" " Selected Esmeralda........	......	2.43	1.45	3.88	3.28	3.46	5.95	8.51	17.92	8.00	9.41	6.00	2.01	2.00	3.21	35.79	....	1251
1493	Groves & Dagett, R. B. Super., stock 1885.	......	tra.	1.08	1.08	1.23	3.30	2.46	4.44	10.20	9.00	5.76	7.00	2.14	2.00	5.76	17.37	....	1493
1517	Garrison & Minch, Bone, Fish & Potash.	0.94	0.21	1.49	2.64	1.64	3.40	3.16	4.38	10.94	8.00	6.56	7.00	4.91	2.00	8.14	26.63	....	1517
1269	" " Pride of Cumberland	0.17	tra.	1.11	1.28	1.64	4.51	1.24	2.63	8.38	8.00	5.75	7.00	2.68	2.00	6.28	17.47	....	1269
1561	John Reed's Delta................................	......	1.00	1.71	2.71	2.46	7.39	2.64	3.17	13.20	....	10.03	8.00	5.50	5.00	6.88	32.13	37.00	1561
1304	Lobos Guano......................	0.16	3.97	0.59	4.72	....	1.00	5.36	7.64	14.00	....	6.36	....	1.74	....	2.21	33.53	....	1304
1347	Quaker City Mfg. Co.'s Q C. Poudrette...	0.27	0.12	1.13	1.52	0.82	0.42	3.17	0.35	3.94	6.00	3.59	....	0.13	2.00	0.17	11.34	....	1347
1408	No. 1 Peruvian Guano.	0.19	4.72	1.23	6.14	....	2.46	6.45	4.75	13.66	....	8.91	....	2.21	....	1.92	41.33	....	1408
1479	A. L. Sardy's Phospho Peruvian Guano..	......	0.12	2.42	2.54	2.46	7.53	1.57	1.84	10.94	10.00	9.10	9.00	2.13	2.00	2.34	26.14	....	1479

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1358	Potato Manure	H. J. Baker & Bro., New York.	Franklin Dye, Trenton.	1358
1370	Oat Manure	" " " "	J. H. Denise, Freehold.	1370
1381	Fruit Tree Manure	" " " "	" " "	1381
1404	Onion Manure	" " " "	" " "	1404
1405	Strawberry Manure	" " " "	" " "	1405
1472	A. A. Ammoniated Superphosphate	" " " "	J. M. White, New Brunswick.	1472
1473	Pelican Bone Fertilizer	" " " "	" " " "	1473
1507	Corn Manure	" " " "	T. F. Baker, Bridgeton.	1507
1255	Ammoniated Superphosphate	H. Doughten, Moorestown, N. J.	H. I. Budd, Mt. Holly.	1255
1257	Potato Manure	" " " "	" " "	1257
1298	Peach and Fruit, Special	Clark's Cove Guano Company, New Bedford, Mass.	I. W. Nicholson, Camden.	1298
1299	Great Planet Formula "B"	" " " " " "	" " "	1299
1301	Unicorn	" " " " " "	" " "	1301
1371	Great Planet Formula "A"	" " " " " "	J. H. Denise, Freehold.	1371
1505	King Philip	" " " " " "	T. F. Baker, Bridgeton.	1505
1526	Bay State	" " " " " "	J. J. Mitchell, Whippany.	1526

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
1358	Baker's Potato Manure...........................	......	3.16	0.82	3.98	3.28	5.41	0.86	trace.	6.27	6.25	6.27	5.75	10.07	10.00	3.17	34.53	45.00	1358
1370	“ Oat Manure................	......	3.55	1.00	4.55	4.10	5.43	0.61	trace.	6.04	....	6.04	5.00	8.81	9.00	9.94	33.70	45.00	1370
1381	“ Fruit Tree Manure......................	......	1.42	0.51	1.93	1.64	5.64	0.72	0.26	6.62	....	6.36	6.00	10.37	11.00	2.32	27.94	43.00	1381
1404	“ Onion “	......	3.24	1.04	4.28	4.92	7.18	1.04	0.29	8.51	5.50	8.22	4.50	8.53	9.00	6.24	36.15	45.00	1404
1405	“ Strawberry “	......	1.74	1.03	2.77	2.66	5.43	1.08	0.15	6.66	7.00	6.51	6.00	8.21	8.00	1.92	28.83	42.50	1405
1472	“ A. A. Ammoniated Superphos...	......	2.49	0.91	3.40	2.46	11.29	0.39	0.21	11.89	13.00	11.68	10.00	2.35	2.00	2.96	33.11	37.50	1472
1473	“ Pelican Bone Fertilizer.............	......	0.52	1.12	1.64	1.85	9.87	0.49	0.26	10.62	10.00	10.36	9.00	2.29	2.25	5.45	24.41	32.50	1473
1507	“ Corn Manure............................	......	3.57	1.16	4.73	4.10	5.99	0.16	0.29	6.44	7.25	6.15	6.25	6.84	7.00	7.55	32.96	45.00	1507
1255	Doughten's Ammoniated Superphos......	......	0.30	2.67	2.97	2.05	7.85	1.04	1.41	10.30	....	8.89	9.00	0.81	....	2.41	25.95	31.00	1255
1257	“ Potato Manure......................	......	1.03	2.11	3.14	3.28	7.22	0.48	1.38	9.08	8.00	7.70	7.00	6.58	6.00	7.62	29.72	40.00	1257
1298	Clark's Cove Peach and Fruit, Special ...	0.32	0.09	0.76	1.17	0.61	5.37	1.07	1.70	8.14	7.00	6.44	5.50	6.81	6.00	9.35	21.20	30.00	1298
1299	“ Great Planet Formula “B”........	2.06	2.03	1.24	5.33	4.94	5.40	0.76	0.94	7.10	6.00	6.16	5.00	7.29	7.00	2.78	36.85	46.00	1299
1301	“ Unicorn....................................	......	0.23	2.17	2.40	1.85	6.18	2.85	2.81	11.84	10.00	9.03	8.50	2.63	2.25	1.42	26.79	33.00	1301
1371	“ Great Planet Formula “A”..........	......	2.56	2.27	4.83	3.28	7.22	0.41	0.84	8.47	8.25	7.63	7.25	9.18	9.50	7.22	37.70	44.00	1371
1505	“ King Philip................................	0.10	0.07	1.40	1.57	1.23	4.92	2.11	4.23	11.26	7.50	7.03	6.50	5.44	3.00	3.11	24.13	28.00	1505
1526	“ Bay State....................................	......	1.36	1.69	3.05	2.46	9.23	0.41	2.19	11.83	11.00	9.64	10.00	2.75	2.00	1.18	30.15	38.00	1526

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1568	Union Co. Fertilizer	Theo. Glaser, Linden, N. J.	J. J. Mitchell, Whippany.	1568
1570	Newark Poudrette	Ebeling Bros., Newark, N. J.	" " "	1570
1312	High Grade Ammoniated Bone	E. Frank Coe, 16 Burling Slip, N. Y.	J. H. Denise, Freehold.	1312
1315	Excelsior Red Brand	" " " " "	" " "	1315
1318	High Grade Knickerbocker	" " " " "	J. M. White, New Brunswick.	1318
1319	Ralston's Ammoniated Bone Superphosphate	" " " " "	" " " "	1319
1320	Potato Manure	" " " " "	" " " "	1320
1357	Alkaline Bone	" " " " "	Franklin Dye, Trenton.	1357
1367	Peach Tree Fertilizer	" " " " "	J. H. Denise, Freehold.	1367
1443	XXV. Phosphate	" " " " "	Franklin Dye, Trenton.	1443
1558	Ammoniated Bone Superphosphate	" " " " "	J. J. Mitchell, Whippany.	1558
1559	Excelsior	" " " " "	" " "	1559
1341	Virginius	Powell, Morse & Co., Hoffman's Wharf, Va.	H. I. Budd, Mt. Holly.	1341
1509	Ocean Guano	" " " " " "	T. F. Baker, Bridgeton.	1509
1413	Truxillo Guano	Lord & Polk, Odessa, Del.	I. W. Nicholson, Camden.	1413
1415	Bone Phosphate	T. Clancy, New Brunswick, N. J.	J. M. White, New Brunswick.	1415

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
1568	Theo. Glaser, Union Co. Fertilizer	......	0.26	1.21	1.47	1.64	5.03	0.78	3.03	8.84	10.00	5.81	....	2.57	2.00	5.76	18.37	....	1568
1570	Ebeling Bros.' Newark Poudrette	0.13	tra.	0.77	0.90	....	0.56	1.60	0.26	2.42	....	2.16	....	0.31	....	0.17	7.01	....	1570
1312	Coe's High Grade Ammoniated Bone	......	0.30	1.88	2.18	2.05	7.68	1.40	2.90	11.98	10.00	9.08	9.00	1.87	1.00	0.87	25.53	....	1312
1315	" Excelsior Red Brand	......	0.98	2.70	3.68	3.28	8.06	1.31	1.05	10.42	....	9.37	10.00	4.41	4.86	0.57	33.11	....	1315
1318	" High Grade Knickerbocker	......	0.52	1.70	2.22	1.85	8.58	1.02	3.32	12.92	10.00	9.60	9.00	1.28	1.00	0.35	26.34	....	1318
1319	" Ralston's Am. Bone Superphos.	......	0.18	1.71	1.89	0.82	7.33	1.66	2.03	11.02	....	8.99	9.00	4.42	2.72	0.51	26.78	....	1319
1320	" Potato Manure	......	0.19	1.59	1.78	1.64	7.49	1.56	2.00	11.05	10.00	9.05	8.00	4.45	3.80	0.48	26.52	....	1320
1357	" Alkaline Bone	......	0.16	1.29	1.45	0.82	8.10	1.36	3.38	12.84	10.00	9.46	9.00	1.68	1.63	0.29	23.90	....	1357
1367	" Peach Tree Fertilizer	......	0.18	1.41	1.59	0.82	7.26	1.36	3.16	11.78	....	8.62	6.00	3.93	4.86	0.80	25.21	....	1367
1443	" XXV. Phosphate	......	0.17	1.24	1.41	0.82	7.35	2.42	3.46	13.23	9.00	9.77	7.00	1.26	0.81	1.36	23.64	....	1443
1558	" Ammoniated Bone Superphos.	......	0.09	1.71	1.80	1.64	7.66	0.13	3.90	11.69	....	7.79	8.00	1.41	1.00	0.41	22.37	....	1558
1559	" Excelsior	......	1.00	2.37	3.37	3.28	8.81	1.60	1.34	11.75	10.00	10.41	10.00	3.24	2.72	0.43	32.64	....	1559
1341	Powell, Morse & Co., Virginius	tra.	0.93	2.91	3.84	3.28	0.58	7.17	4.41	12.19	9.00	7.75	7.00	1.68	1.00	3.08	29.83	....	1341
1509	" " " Ocean Guano	......	0.55	1.54	2.09	1.64	2.34	4.67	4.51	11.55	11.00	7.01	8.00	1.77	1.00	1.42	22.71	....	1509
1413	Lord & Polk's Truxillo Guano	......	2.99	0.40	3.39	2.46	8.85	0.88	2.49	12.22	10.00	9.73	9.00	5.66	5.00	4.68	34.29	35.00	1413
1415	Clancy's Bone Phosphate	......	0.19	1.20	1.39	1.64	1.56	3.33	2.85	7.74	....	4.89	8.00	1.76	2.00	3.94	15.82	....	1415

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1434	Soluble Pacific Guano	Pacific Guano Company, Boston, Mass.	J. H. Denise, Freehold.	1434
1451	Cereal Fertilizer	Newton & Ludlam, 182 Front St., N. Y.	J. M. White, New Brunswick.	1451
1268	Star Bone Phosphate	J. E. Tygert & Co., Philadelphia, Pa.	T. F. Baker, Bridgeton.	1268
1332	Complete Fertilizer for Potatoes, Truck and Tobacco	John Taylor & Co., Trenton, N. J.	J. M. White, New Brunswick.	1332
1342	" " " Wheat, Oats and Grass	" " " "	H. I. Budd, Mt. Holly.	1342
1359	Ammoniated Dissolved Bone and Potash	" " " "	Franklin Dye, Trenton.	1359
1360	Complete Fertilizer for Corn and Truck	" " " "	" " "	1360
1385	Arlington B., for all Crops	Dambmann Bros. & Co., Baltimore, Md.	J. M. White, New Brunswick.	1385
1388	Alpha Soluble Bone and Potash	" " " " "	" " " "	1388
1439	Arlington Fertilizer for Truck	" " " " "	J. H. Denise, Freehold.	1439
1524	Wheat, Corn and Oat Fertilizer	" " " " "	J. J. Mitchell, Whippany.	1524
1394	Cook's Blood Guano	Read & Co., 88 Wall St., New York.	J. M. White, New Brunswick.	1394
1423	Ammoniated Bone Superphosphate	Williams, Clark & Co., 101 Pearl St., New York.	H. I. Budd, Mt. Holly.	1423
1441	Americus Potato Fertilizer	" " " " " "	J. H. Denise, Freehold.	1441
1462	Royal Bone	" " " " " "	J. M. White, New Brunswick.	1462
1425	Potato Fertilizer	Wenderoth & Son, Camden, N. J.	H. I. Budd, Mt. Holly.	1425

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Prices of 2,000 Pounds at Factory.	Station number.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
1434	Pacific Guano Co.'s Soluble Pacific Guano......	tra.	0.16	2.40	2.56	2.05	6.47	0.55	5.15	12.17	....	7.02	6.00	2.08	2.00	3.03	24.84	....	1434
1451	Newton & Ludlam's Cereal Fertilizer............	......	0.13	1.25	1.38	1.23	9.96	1.07	1.82	12.85	12.00	11.03	9.50	1.70	2.00	2.70	24.92	....	1451
1268	Tygert & Co.'s Star Bone Phosphate...............	......	tra.	2.00	2.00	1.85	6.45	2.07	3.16	11.68	10.50	8.52	8.50	2.58	2.50	4.24	24.52	33.00	1268
1332	Taylor's Com., for Potatoes, Truck & Tobacco	......	1.11	1.85	2.96	2.46	7.20	3.80	2.64	13.64	11.00	11.00	9.00	10.34	10.00	9.56	38.36	45.00	1332
1342	" " " Wheat, Oats and Grass........	......	0.88	2.06	2.94	2.46	6.91	2.21	3.56	12.68	13.00	9.12	9.00	3.08	2.50	2.90	29.62	34.00	1342
1359	" Am. Dissolved Bone and Potash.........	......	0.73	1.15	1.88	1.23	4.76	3.37	3.86	11.99	9.00	8.13	7.00	2.84	2.00	7.90	24.35	25.00	1359
1360	" Com. Fertilizer for Corn and Truck...	......	0.99	1.46	2.45	2.46	4.32	4.59	5.43	14.34	13.00	8.91	9.00	5.63	5.00	5.80	30.92	35.00	1360
1385	Dambmann's Arlington B., for all Crops.........	......	0.08	2.10	2.18	1.75	8.58	0.94	2.10	11.62	11.50	9.52	7.25	2.33	2.12	2.00	25.91	33.00	1385
1388	" Alpha Soluble Bone and Potash	......	tra.	......	tra.	....	8.98	1.50	2.38	12.86	11.50	10.48	10.50	2.68	2.75	3.99	20.48	25.00	1388
1439	" Arlington Fertilizer for Truck...	0.59	0.12	2.23	2.94	3.28	8.50	0.80	1.52	10.82	10.50	9.30	9.00	2.43	2.50	2.66	28.06	39.00	1439
1524	" Wheat, Corn and Oat Fertilizer..	......	0.11	1.76	1.87	1.45	8.23	1.50	2.30	12.03	10.00	9.73	9.00	1.54	1.75	2.62	24.65	30.00	1524
1394	Read & Co.'s Cook's Blood Guano....................	......	0.20	2.45	2.65	1.64	7.10	1.65	2.60	11.35	10.00	8.75	7.00	2.80	....	3.21	27.01	....	1394
1423	Williams, Clark & Co.'s Am. Bone Superphos..	......	0.15	2.76	2.91	2.46	9.40	1.99	0.83	12.22	11.00	11.39	10.00	2.60	2.00	0.54	31.35	36.00	1423
1441	" " " Americus Potato Fert.	......	1.70	1.90	3.60	3.28	6.60	1.08	0.87	8.55	7.00	7.68	6.00	8.46	8.00	0.51	34.70	42.00	1441
1462	" " " Royal Bone................	......	0.16	1.36	1.52	0.82	6.87	1.61	1.64	10.12	8.00	8.48	7.00	2.66	2.00	1.53	22.17	28.00	1462
1425	Wenderoth's Potato Fertilizer	......	0.21	2.67	2.88	2.05	6.24	1.58	3.26	11.08	10.00	7.82	8.00	4.27	3.00	4.16	27.96	33.25	1425

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1482	Soluble Tampico Guano	Sharpless & Carpenter, Philadelphia, Pa.	Franklin Dye, Trenton.	1482
1516	No. 1 Bone Phosphate	" " " "	T. F. Baker, Bridgeton.	1516
1495	Tip Top	I. P. Thomas, Philadelphia, Pa.	" " "	1495
1496	Normal Superphosphate	" " " "	" " "	1496
1278	Ammoniated Phosphate	Yarnell N. J. Chemical Co., Camden, N. J.	H. I. Budd, Mt. Holly.	1278
1279	Yarnell's Fish	" " " " " "	" " "	1279
1281	" High Grade Potato	" " " " " "	" " "	1281
1282	" Bone	" " " " " "	" " "	1282
1283	W. and C. Superphosphate	" " " " " "	" " "	1283
1412	Acidulated Fish Guano	N. J. Chemical Co., Camden, N. J.	I. W. Nicholson, Camden.	1412
1477	I. L. Lofland's Button Bone	" " " " "	J. M. White, New Brunswick.	1477
1287	National Potato Fertilizer	U. S. Chemical Co., 3 South Front, Philadelphia.	H. I. Budd, Mt. Holly.	1287
1288	" Tobacco "	" " " " " "	" " "	1288
1291	" Lawn "	" " " " " "	" " "	1291
1845	" Superphosphate	" " " " " "	" " "	1845
1595	Griffin's Superphosphate	H. B. Griffin, 70 Cortlandt St., New York City.	Assistant Chemist of Station.	1595

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.					
												Available.							
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
1482	Sharpless & Carpenter's Sol. Tamp. Guano.	......	0.17	2.00	2.17	2.46	6.12	2.08	4.79	12.99	....	8.20	8.00	3.15	....	3.41	26.11	....	1482
1516	" " " No. 1 Bone Phos....	....	tra.	1.12	1.12	1.23	4.40	2.38	4.64	11.42	....	6.78	6.00	1.57	1.50	4.07	18.77	....	1516
1495	I. P. Thomas' Tip Top..........	0.45	tra.	2.00	2.45	2.05	7.49	2.26	3.13	12.88	13.00	9.75	10.00	2.36	2.50	2.39	27.96	36.00	1495
1496	" " Normal Superphosphate.....	0.24	tra.	1.00	1.24	0.82	4.45	3.35	3.55	11.35	9.00	7.80	7.00	2.73	1.50	4.54	21.22	25.00	1496
1278	N. J. Chem. Co. Ammoniated Phosphate.	......	0.27	0.87	1.14	0.82	7.95	1.01	2.88	11.84	....	8.96	9.00	2.45	1.50	6.97	22.11	....	1278
1279	" " " Yarnell's Fish..........	......	0.22	1.32	1.54	2.05	7.24	1.51	3.39	12.14	....	8.75	9.00	1.82	3.00	4.79	22.88	....	1279
1281	" " " " High Grade Potato.	......	0.90	2.09	2.99	3.28	7.10	1.68	2.36	11.14	....	8.78	9.00	5.09	5.00	4.97	30.24	....	1281
1282	" " " " Bone..........	......	0.94	1.65	2.59	1.64	7.70	1.31	2.43	11.44	11.00	9.01	....	3.49	3.00	3.41	27.94	....	1282
1283	" " " W. & C. Superphosphate...	......	0.65	1.32	1.97	2.05	6.81	1.25	4.89	12.98	13.00	8.09	10.00	2.11	1.00	2.78	24.56	35.00	1283
1412	" " " Acidulated Fish Guano...	......	0.30	1.46	1.76	2.05	6.34	0.70	4.93	11.97	13.00	7.04	10.00	1.98	1.50	1.83	21.97	36.00	1412
1477	" " " I. L. Lofland's But'n Bone	......	1.11	0.55	1.66	1.23	5.41	2.51	3.02	10.94	11.50	7.92	10.00	3.62	3.00	5.05	23.55	37.00	1477
1287	U. S. Chem. Co.'s Nat'l Potato Fertilizer...	......	tra.	1.55	1.55	1.50	4.63	2.82	2.65	10.10	9.00	7.45	8.00	2.37	3.00	3.32	20.79	35.00	1287
1288	" " " " Tobacco Fertilizer	......	tra.	1.32	1.32	1.64	7.30	2.78	3.39	13.47	13.50	10.08	8.00	1.03	....	1.28	23.53	38.00	1288
1291	" " " " Lawn Fertilizer ...	0.52	tra.	1.73	2.25	....	6.80	2.29	2.30	11.39	....	9.09	....	4.10	....	3.75	27.21	38.00	1291
1345	" " " " Superphosphate...	......	tra.	1.17	1.17	1.50	7.10	2.74	3.00	12.84	11.00	9.84	10.00	1.71	2.00	1.90	22.97	33.00	1345
1595	H. B. Griffin's Superphosphate..........	......	0.59	1.73	2.32	1.23	2.59	0.57	0.74	3.90	....	3.16	6.00	2.96	1.50	2.27	16.07	....	1595

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1293	Superphosphate	Moro Phillips, Philadelphia, Pa.	H. I. Budd, Mt. Holly.	1293
1294	Phuine	" " " "	" " "	1294
1401	Potato Fertilizer	Preston Fertilizer Co., Greenpoint, L. I.	J. H. Denise, Freehold.	1401
1484	Ammoniated Bone Phosphate	" " " " "	Franklin Dye, Trenton.	1484
1549	" " Superphosphate	" " " " "	J. J. Mitchell, Whippany.	1549
1551	Corn Fertilizer	" " " " "	" " "	1551
1313	Swift Sure Phosphate	M. L. Shoemaker & Co., Philadelphia, Pa.	J. H. Denise, Freehold.	1313
1447	$23 Superphosphate	" " " " "	Franklin Dye, Trenton.	1447
1572	Good Enough Superphosphate	" " " " "	H. I. Budd, Mt. Holly.	1572
1573	Echo	" " " " "	" " "	1573
1392	Potato Fertilizer	J. P. White's Sons, 41 Peck slip, New York City.	J. M. White, New Brunswick.	1392
1311	" Manure	Lister Bros, Newark, N. J.	J. H. Denise, Freehold.	1311
1452	Success	" " " "	J. M. White, New Brunswick.	1452
1458	Ammoniated Dissolved Bone	" " " "	" " " "	1458
1459	U. S. Superphosphate	" " " "	" " " "	1459
1530	Corn Manure	" " " "	J. J. Mitchell, Whippany.	1530
1532	Standard	" " " "	" " "	1532

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
1293	Moro Phillips' Superphosphate...........	......	0.08	1.84	1.92	1.64	6.82	1.68	3.00	11.50	....	8.50	8.00	2.34	2.16	0.96	24.21	....	1293
1294	“ Phuine...........................	......	0.20	2 06	2.26	1.64	4.88	0.98	3.68	9.54	....	5.86	7.00	2.90	2.00	0.93	22.21	....	1294
1401	Preston's Potato Fertilizer....................	......	0.90	2.60	3.50	3.28	6.78	0.98	1.30	9.06	....	7.76	8.00	5.43	7.00	2.73	30.43	....	1401
1484	“ Am. Bone Phosphate...........	......	0.29	2.68	2.97	2.45	6.89	1.19	2.83	10.91	....	8.08	8.00	0.81	....	1.73	25.49	....	1484
1549	“ “ Superphosphate...	......	0.21	2.46	2.67	2.05	6.83	0.79	2.57	10.19	....	7.62	8.00	1.20	1.00	3.34	23.89	27.00	1549
1551	“ Corn Fertilizer..	......	0.83	1.93	2.76	2.46	5.80	1.44	1.22	8.46	....	7.24	9.00	7.51	7.00	3.95	28.88	....	1551
1313	Shoemaker's Swift Sure Superphos......	0.61	0.07	2.39	3.07	2.46	9.14	2.86	1.88	13.88	14.00	12.00	9.00	5.23	4.00	4.45	35.44	36.00	1313
1447	“ $23 Superphosphate.........	tra.	tra.	1.45	1.45	0.82	7.39	1.14	1.98	10.51	8.00	8.53	6.00	2.20	1.00	4.45	21.63	23.00	1447
1572	“ Good Enough Superphos.	0.26	tra.	1.31	1.57	1.23	9.83	1.50	3.63	14.96	12.00	11.33	8.00	2.22	1.62	2.79	27.60	32.00	1572
1573	“ Echo Superphosphate.....	......	tra.	1.12	1.12	0.82	7.04	1.25	2.89	11.18	9.00	8.29	7.00	2.05	1.00	4.56	20.54	25.00	1573
1392	J. P. White's Sons' Potato Fertilizer....	......	0.49	2.54	3.03	2.46	8.18	1.23	2.13	11.54	14.00	9.41	9.00	4.21	4.32	3.73	30.37	40.00	1392
1311	Lister's Potato Manure......................	......	4.06	0.76	4.82	3.69	9.00	0.22	tra.	9.22	....	9.22	8.50	8.20	7.00	7.72	39.33	44.00	1311
1452	“ Success..................................	......	0.78	1.02	1.80	0.82	12.21	0.22	0.42	12.85	....	12.43	10.00	2.07	2.00	0.39	28.64	27.00	1452
1458	“ Ammoniated Dissolved Bone..	......	0.60	1.79	2.39	1.64	8.22	2.27	1.44	11.93	10.00	10.49	8.00	1.64	1.50	2.16	27.34	32.00	1458
1459	“ U. S. Superphosphate.	......	0.43	1.16	1.59	1.31	6.14	2.05	1.09	9.28	7.00	8.19	6.00	2.57	2.00	5.96	21.46	....	1459
1530	“ Corn Manure..............................	......	2.76	1.55	4.31	3.69	8.83	0.12	0.38	9.33	....	8.95	9.00	6.13	7.00	6.33	35.24	45.00	1530
1532	“ Standard..................................	......	0.83	1.74	2.57	2.33	9.31	1.70	1.02	12.03	12.00	11.01	10.00	2.13	1.50	2.61	29.03	35.00	1532

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1260	Planet Fertilizer	Peninsular Fertilizing Co., Smyrna, Del.	H. I. Budd, Mt. Holly.	1260
1339	Special Fish Manure	J. C. Gaskill, Birmingham, N. J.	" " " "	1339
1421	High Grade	" " " "	" " " "	1421
1436	Popular Phosphate	" " " "	J. H. Denise, Freehold.	1436
1534	High Grade Bone Superphosphate	Depue, Son & Co., Belvidere, N. J	D. F. Pursel, New Village.	1534
1535	Extra Bone Superphosphate	" " " " "	" " " "	1535
1537	Bone, Animal Matter, Kainite, &c	" " " " "	" " " "	1537
1569	Normal, No. 1	Excelsior Fertilizing Co., New York.	J. J. Mitchell, Whippany.	1569
1591	Potato Manure	G. B. Forrester, Brooklyn, N. Y.	A. W. Duryee.	1591
1364	Standard Grain and Grass Fertilizer	John I. Smith, Trenton, N. J.	Franklin Dye, Trenton.	1364
1373	Potato and Truck Fertilizer	" " " "	" " "	1373
1368	Acme Fertilizer	C. Meyer, Jr., Maspeth, L. I.	J. H. Denise, Freehold.	1368
1376	Plow Brand	Walton, Whann & Co., Wilmington, Del.	" " "	1376
1398	Chittenden's Universal Phosphate	National Fertilizer Co., Bridgeport, Conn.	" " "	1398
1521	" Ammoniated Bone Superphosphate	" " " " "	J. J. Mitchell, Whippany.	1521
1522	" Fertilizer for Potatoes, Vegetables, &c	" " " " "	" " "	1522
1586	" Fish and Potash	" " " " "	J. H. Denise, Freehold.	1586

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.		Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
1260	Peninsular Fert. Co., Planet Fertilizer......	......	0.04	1.44	1.48	1.23	7.23	1.53	2.86	11.62	8.00	8.76	7.00	2.18	2.00	3.91	22.63	....	1260
1339	Gaskill's Special Fish Manure....................	......	0.12	2.00	2.12	2.46	5.57	1.20	1.55	8.32	7.00	6.77	6.00	3.67	4.00	6.97	22.12	34.00	1339
1421	" High Grade.....................................	tra.	0.13	2.86	2.99	3.28	5.18	0.91	2.50	8.59	8.00	6.09	6.00	5.65	6.00	6.54	26.25	44.00	1421
1436	" Popular Phosphate	......	0.14	2.01	2.15	2.46	6.43	0.96	2.71	10.10	7.00	7.39	6.00	3.84	4.00	4.25	24.07	34.00	1436
1534	Depue's High Grade Bone Superphosphate	......	0.38	1.30	1.68	2.00	2.59	2.79	1.54	6.92	10.00	5.38	....	6.15	5.00	8.10	20.58	32.00	1534
1535	" Extra Bone Superphosphate.........	0.20	0.11	0.59	0.90	2.00	3.00	1.71	2.27	6.98	8.00	4.71	....	2.66	4.00	6.22	14.32	28.00	1535
1537	" Bone, Animal Matter, Kainite, &c.	tra.	0.15	0.27	0.42	2.00	1.00	0.98	0.77	2.75	5.00	1.98	....	5.46	4.00	11.75	9.75	20.00	1537
1569	Excelsior Fert. Co.'s Normal, No. 1............	......	0.10	2.40	2.50	2.00	7.22	1.21	0.26	8.69	....	8.43	7.50	3.41	3.00	7.80	25.08	....	1569
1591	Forrester's Potato Manure.........................	tra.	4.59	......	4.59	3.48	7.24	0.36	0.22	7.82	....	7.60	5.25	9.35	10.00	3.15	38.50	45.00	1591
1364	J. I. Smith's Standard Grain and Grass Fert.	......	0.13	2.90	3.03	2.05	4.36	4.01	0.99	9.36	10.00	8.37	....	3.51	3.00	8.57	27.31	....	1364
1373	" Potato and Truck Fertilizer....	......	0.85	2.32	3.17	2.46	5.34	2.43	0.74	8.51	9.00	7.77	....	8.54	7.00	10.51	31.17	....	1373
1368	C. Meyer, Jr., Acme Fertilizer.....................	......	3.17	1.45	4.62	3.69	7.39	1.29	0.40	9.08	9.00	8.68	8.00	10.32	9.00	5.25	40.38	43.00	1368
1376	Walton, Whann & Co.'s Plow Brand..........	......	0.09	2.38	2.47	2.25	5.82	2.23	4.47	12.52	11.00	8.05	9.00	2.10	2.25	2.39	25.77	33.00	1376
1398	Nat. Fert. Co.'s Univ. Phos., Chittenden's..	......	0.06	2.64	2.70	2.05	5.78	3.52	3.03	12.33	10.00	9.30	8.00	2.33	2.00	2.68	27.88	35.00	1398
1521	" Chittenden's Am. Bone Superphos....	......	tra.	2.54	2.54	1.64	6.87	2.14	2.73	11.74	9.00	9.01	7.00	1.87	2.00	4.27	26.28	30.00	1521
1522	" " Fert., Potatoes, Vegetables, &c..	......	0.97	3.36	4.33	3.28	4.32	2.10	3.40	9.82	8.00	6.42	6.00	9.14	6.00	8.29	35.09	40.00	1522
1586	" " Fish and Potash.........................	......	0.92	3.82	4.74	3.28	2.03	3.69	1.41	7.13	6.00	5.72	....	3.99	5.00	5.84	29.78	35.00	1586

COMPLETE FERTILIZERS

Furnishing Nitrogen, Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1256	Doughten's Fish Guano	H. Preston Fertilizer Co., Greenpoint, L. I.	H. I. Budd, Mt. Holly, N. J.	1256
1350	Dried Ground Fish Guano	James E. Otis, Tuckerton, N. J.	" " " "	1350
1582	Dried Ground Fish	J. J. Allen's Sons, Philadelphia.	" " " "	1582
1600	Ringoes Formula	Charles D. Coe, dealer, Flemington, N. J.	J. W. Swallon, Copper Hill, N. J.	1600
1601	Gaskill's High Grade Manure	Walton, Whann & Co., Wilmington, Del.	H. I. Budd, Mt. Holly, N. J.	1601

Analyses and Valuations.

Station number.	BRAND.	Nitrogen.					Phosphoric Acid.							Potash.		Chlorine.	Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds.	Station number.
		From Nitrates.	From Ammonia Salts.	From Organic Matter.	Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available.		Found.	Guaranteed.				
												Found.	Guaranteed.						
1256	Doughten's Dried and Ground Fish Guano	......	......	4.06	4.06	4.12	2.46	2.19	2.82	7.47	5.00	4.65	....	0.38	....	2.45	22.95	....	1256
1350	James E. Otis' Fish Guano	......	0.91	4.75	5.66	4.12	0.25	3.24	3.00	6.49	7.00	3.48	....	3.20	2.00	7.84	29.62	....	1350
1582	Allen's Ground Fish	......	0.92	1.97	2.89	2.06	3.03	2.31	4.26	9.60	....	5.34	8.00	2.74	2.50	4.94	26.67	....	1582
1600	Coe's Ringoes Formula	......	......	0.79	0.79	2.10	7.05	1.55	2.34	10.94	....	8.60	7.80	0.79	2.30	3.07	18.52	....	1600
1601	Gaskill's High Grade Manure	......	0.16	2.94	3.10	3.28	5.07	1.07	2.47	8.61	8.00	6.14	6.00	5.56	6.00	6.80	26.63	....	1601

GROUND BONE

Furnishing Nitrogen and Insoluble Phosphoric Acid.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1271	Raw Bone	A. W. South, Philadelphia, Pa.	Theo. F. Baker, Bridgeton.	1271
1308	Button Bone	L. Moritz, Philadelphia, Pa.	I. W. Nicholson, Camden.	1308
1337	Bone Meal	Sharpless & Carpenter, Philadelphia, Pa.	H. I. Budd, Mt. Holly.	1337
1349	Star Bone	J. E. Tygert, Philadelphia, Pa.	“ “ “ “	1349
1426	Swift Sure Bone Meal	M. L. Shoemaker & Co., Philadelphia, Pa.	“ “ “ “	1426
1427	“ “ Ground Bone	“ “ “ “ “	“ “ “ “	1427
1429	Fine Bone	Mapes' F. and P. Guano Co., New York.	J. H. Denise, Freehold.	1429
1457	Crescent Bone	Lister Bros., Newark, N. J.	J. M. White, New Brunswick.	1457
1470	Ground Bone	H. Preston & Son, Greenpoint, L. I.	“ “ “ “	1470
1492	Pure Ground Bone	Groves & Dagett, Wilmington, Del.	Theo. F. Baker, Bridgeton.	1492
1494	“ “ “	I. P. Thomas, Philadelphia, Pa.	“ “ “ “	1494
1518	Button Bone	Emil Wahl, Philadelphia, Pa.	“ “ “ “	1518
1519	Fine Animal Bone	National Fertilizer Co., Bridgeport, Conn.	J. J. Mitchell, Whippany.	1519
1527	Pure Bone Meal	Williams, Clark & Co., New York.	“ “ “	1527
1533	Pure Ground Bone	Lister Bros., Newark, N. J.	“ “ “	1533
1538	“ “ “	Depue, Son & Co., Belvidere, N. J.	D. F. Pursel, New Village.	1538
1553	Pure Bone	Crocker Fertilizer Co., Buffalo, N. Y.	John J. Mitchell, Whippany.	1553
1579	Pure Bone Meal	Baugh & Sons, Philadelphia, Pa.	H. I. Budd, Mt. Holly.	1579
1597	Bone Dust	Peter Cooper Glue Factory, New York.	J. M. White, New Brunswick.	1597

GROUND BONE

Furnishing Nitrogen and Insoluble Phosphoric Acid.

Station number.	MANUFACTURER.	MECHANICAL ANALYSIS.					CHEMICAL ANALYSIS.		Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds.	Station number.
		Finer than $\frac{1}{50}$ inch.	Finer than $\frac{1}{25}$ inch.	Finer than $\frac{1}{12}$ inch.	Finer than $\frac{1}{6}$ inch.	Coarser than $\frac{1}{6}$ inch.	Nitrogen.	Phosphoric Acid.			
1271	A. W. South	20.0	33.0	31.6	14.8	0.6	4.09	20.65	34.57	....	1271
1308	L. Moritz	14.4	37.2	30.0	18.4	....	3.86	23.67	36.68	....	1308
1337	Sharpless & Carpenter	44.2	54.0	1.8	....	....	3.91	19.10	36.96	....	1337
1349	J. E. Tygert	31.1	55.0	11.4	2.5	....	2.91	22.17	36.15	....	1349
1426	M. L. Shoemaker & Co	56.6	31.0	11.4	1.0	....	5.62	21.76	45.81	....	1426
1427	" " "	28.0	41.4	19.3	11.3	....	6.36	19.07	41.08	....	1427
1429	Mapes' F. and P. Guano Co	39.4	22.0	19.4	19.2	....	1.64	30.08	39.98	....	1429
1457	Lister Bros	32.0	25.0	23.0	20.0	....	3.98	12.93	26.17	....	1457
1470	H. Preston & Son	12.0	34.0	17.0	16.0	21.0	3.37	11.57	20.36	....	1470
1492	Groves & Dagett	48.7	46.0	5.3	....	....	3.93	20.61	38.99	....	1492
1494	I. P. Thomas	45.3	48.0	6.7	....	....	3.95	20.31	38.41	....	1494
1518	Emil Wahl	40.5	25.5	20.0	14.0	....	4.12	24.08	41.19	....	1518
1519	S. B. Chittenden	35.6	20.7	18.8	20.4	4.5	1.73	13.03	19.60	....	1519
1527	Williams, Clark & Co	51.0	25.0	18.0	6.0	....	4.16	19.40	36.92	....	1527
1533	Lister Bros	26.0	23.9	26.7	23.4	....	4.00	12.25	24.79	....	1533
1538	Depue & Co	5.4	15.3	21.3	33.0	25.0	3.68	16.64	23.48	....	1538
1553	Crocker Fertilizer Co	53.8	27.0	16.0	3.2	....	4.18	20.92	39.49	....	1553
1579	Baugh & Sons	38.5	48.5	13.0	....	....	4.30	22.41	41.37	....	1579
1597	Peter Cooper Glue Co	58.7	17.1	8.0	16.2	....	1.76	28.26	40.36	....	1597

DISSOLVED BONES AND NITROGENOUS SUPERPHOSPHATES

Furnishing Nitrogen and Available Phosphoric Acid.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1309	Fish Guano	Preston & Son, Greenpoint, L. I.	I. W. Nicholson, Camden, N. J.	1309
1446	Ammoniated Dissolved Bone	M. L. Shoemaker & Co., Philadelphia, Pa.	Franklin Dye, Trenton, N. J.	1446
1539	" Bone	Depue, Son & Co., Belvidere, N. J.	D. F. Pursel, New Village, N. J.	1539
1562	Universal Ammoniated Dissolved Bone	Williams, Clark & Co., New York.	J. J. Mitchell, Whippany, N. J.	1562
1578	$25 Phosphate	Baugh & Sons, Philadelphia, Pa.	H. I. Budd, Mt. Holly, N. J.	1578

Analyses and Valuations.

Station number.	BRAND.	Nitrogen.		Phosphoric Acid.							Estimated Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
		Total Nitrogen Found.	Total Nitrogen Guaranteed.	Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available. Found.	Available. Guaranteed.			
1309	Preston's Fish Guano	3.98	3.50	2.69	2.25	2.68	7.62	5.00	4.94	5.00	23.04	....	1309
1446	Shoemaker's Ammoniated Dissolved Bone	1.55	0.82	4.26	3.87	6.37	14.50	....	8.13	8.00	22.10	....	1446
1539	Depue's Ammoniated Bone	2.43	3.00	1.54	4.44	5.89	11.87	14.00	5.98	....	21.35	....	1539
1562	Williams, Clark & Co., Universal Am. Dis. Bone	1.97	1.64	5.63	3.45	2.91	11.99	10.00	9.08	9.00	22.98	....	1562
1578	Baugh & Sons' $25 Phosphate	2.47	2.05	6.14	0.73	4.17	11.04	....	6.87	6.00	21.89	25.00	1578

SOLUBLE BONE AND POTASH

Furnishing Available Phosphoric Acid and Potash.

Station number.	BRAND.	MANUFACTURER.	SAMPLED BY.	Station number.
1343	Soluble Bone and Potash	New Jersey Chemical Co., Camden.	H. I. Budd, Mt. Holly, N. J.	1343
1513	Bowker's Superphosphate with Potash	Bowker Fertilizer Co., New York.	Theo. F. Baker, Bridgeton, N. J.	1513
1599	Alkaline Phosphate	Arthur L. Sardy, New York.	C. H. Broach, Blackwell's Mills, N. J.	1599

Analyses and Valuations.

Station number.	BRAND.	Phosphoric Acid.							Potash.		Chlorine.	Estimated Value of 2,000 Pounds at Station Prices.	Selling Price of 2,000 Pounds at Factory.	Station number.
		Soluble in Water.	Soluble in Ammonium Citrate.	Insoluble.	Total Phosphoric Acid Found.	Total Phosphoric Acid Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.				
1343	N. J. Chemical Co.'s Soluble Bone and Potash	9.37	1.41	3.06	13.84	....	10.78	11.00	4.91	2.50	4.83	23.26	....	1343
1513	Bowker's Superphosphate with Potash	9.10	1.70	1.08	11.88	....	10.80	11.00	1.56	1.10	3.20	19.28	19.00	1513
1599	Sardy's Alkaline Phosphate	9.35	2.12	1.52	12.99	10.00	11.47	9.00	2.40	3.00	2.20	21.30	....	1599

MISCELLANEOUS SAMPLES.

No. 1395. Rotted Bone Manure, Decomposed with Potash. Geo. W. Baker, Maspeth, L. I.

GUARANTEED ANALYSIS.

	Per cent.
Nitrogen	2.52
Phosphoric Acid	3.27
Potash	3.07

ANALYSIS.

	Per cent.
Nitrogen	2.59
Phosphoric Acid	5.59
Potash	0.07

No. 1478. Carey & Brothers' Excelsior Fertilizer. Carey & Brothers, Lumberville, Pa.

MANUFACTURERS' GUARANTEE.

	Per cent.	
Sulphate of Potash	25.00	
" " Magnesia	4.64	
Chloride of Sodium	43.96	
Moisture	17.24	
Insoluble Matter	5.43	containing silica 0.67 per cent.

ANALYSIS.

	Per cent.	
Nitrogen	0.32	
Potash K_2O	0.06	
Chlorine	38.69	equivalent to 63.83 sodium chloride.
Lime	5.97	
Moisture	7.70	
Insoluble Matter	11.25	

No. 1598. Canada Unleached Ashes. Charles Stevens Napanee, Ontario, Canada. Sampled by Ralph Van Pelt, Bound Brook, N. J.

GUARANTEE.

	Per cent.
Oxide of Potassium	6.00

CONTAINS.

	Per cent.
Phosphoric Acid	1.56
Potash	5.02
Lime	39.10

The three samples of leached ashes analyzed during the past season were sampled by Mr. Theo. F. Baker, of Bridgeton, N. J. The selling prices ranged from 15 to 17 cents per bushel.

The analyses show that these samples contain much lower percentages of phosphoric acid and potash than any leached ashes hitherto brought under the Station's notice; the percentages of lime also fall considerably below normal amounts.

For the sake of comparison, the analyses have been tabulated, with maximum, minimum and average records published in Reports of the Connecticut, Massachusetts and New Jersey Stations.

Samples 1128, 1129 and 1130 are thereby shown to contain from one-fourth to one-eighth only of the quantities of potash and phosphoric acid usually found in leached ashes:

Station number.	MANUFACTURER.	PERCENTAGE OF			
		Water.	Lime.	Phosphoric Acid.	Potash.
	LEACHED ASHES.				
1128	James Tully, Philadelphia	34.30	23.36	0.29	0.37
1129	J. S. Young & Co., Baltimore	29.29	33.52	0.15	0.16
1130	James Tully, Philadelphia	28.01	23.36	0.28	0.37
	Average	30.53	26.75	0.24	0.30
	LEACHED WOOD ASHES.				
	Connecticut Station Reports—Maximum Potash	35.00	28.10	1.30	2.30
	Connecticut Station Reports—Minimum Potash	35.00	23.20	1.40	0.70
	Average	32.24	27.66	1.42	1.20
	LEACHED WOOD ASHES.				
	Massachusetts Station Reports—Maximum Potash	14.40	34.33	1.79	2.25
	Massachusetts Station Reports—Minimum Potash	24.53	26.53	1.89	0.79
	Average	16.32	34.28	1.98	1.49
	LEACHED WOOD ASHES.				
	New Jersey Station Reports—Maximum Potash	....	33.92	1.88	1.89
	New Jersey Station Reports—Minimum Potash	....	29.60	1.10	0.66
	Average	....	37.73	1.31	1.46

II.

AGRICULTURAL RELATIONS OF FERTILIZERS.

The preceding chapter of this report has been devoted exclusively to the discussion of questions which bear upon the commercial relations of fertilizers. These include statistics of sales in this State, reports upon the prices which have ruled in the wholesale and retail markets, the comparisons between the official analyses of complete manures and the guarantees which their manufacturers are legally obliged to publish, &c., all of which deal simply with the purchase and sale of fertilizers and have nothing to do, directly, with the benefits which may result to farmers who use them.

The following chapter excludes, as far as possible, all questions relating to the sales of fertilizers, and is devoted to the reports of the results which have followed their use.

Field trials, which have been carried out under the Station's directions in several sections of this State, have had several distinct ends in view, viz.:

I. To prove that profitable returns cannot always be secured even when the highest grades of fertilizers are used throughout an entire rotation.

This has been discussed in the report on the College Farm rotation. Products were increased, but the profits were not apparent. Mr. Arnold's rotation illustrates the other side of this question. In this case large profits followed the use of fertilizers, particularly upon one or two crops.

II. To examine certain provisions of the State laws on fertilizers, which at present are claimed to be unfair and unjust.

This refers to those details of chemical analyses which practically exclude from the trade phosphoric acid drawn from certain sources. The agricultural value of such phosphates has been studied in numerous field trials, which are reported in detail. The results fail to indicate that farmers' interests demand at present that changes or amendments should be made to the act now in force.

III. To study the effects of fertilizers upon sugar development in sorghum.

The action of the leading elements of plant-food upon the stand of cane, the growth of cane, and the yields of sugar per acre and per ton of cane, have been again studied and former conclusions thereby corroborated.

IV. To direct attention to the agricultural value of low-priced waste products from manufactories.

The wool-waste experiments, begun in 1884, have been continued, and the development of clover, under certain conditions, noted and reported.

V. To test, roughly, the effects of plant-food upon certain soils and crops, at the same time to give farmers an opportunity to familiarize themselves with the appearance and the effects of the materials which, when mixed, form complete manures.

Experiments upon peach trees, rye and clover, reported at the close of this chapter, are examples of this work.

FIELD EXPERIMENTS UPON THE COLLEGE FARM,

NEW BRUNSWICK, MIDDLESEX COUNTY.

This farm contains approximately ninety-five acres, of which ninety acres, at least, is arable land. Its principal product is milk, sold for direct consumption both at wholesale and retail; its annual sales also include the wheat from thirteen acres, the rye from three or four acres, and varying amounts of rye straw and timothy hay.

The herd of forty milch cows, and the teams of working horses and mules consume all of the corn, oats and fodder grown upon the place, and large supplies of brewers' grains, bran and mixed feed are also purchased every year for their support. For a farm of this size, therefore, the available yard manure is far above the average both in quantity and quality.

In accordance with the opinions recognized in this section of the State, barn-yard manure is always spread on the sod which is to be turned under for corn. Oats, following corn in rotation, are grown without additional fertilizers, but the oat stubble is heavily manured for wheat, and an acid phosphate is usually drilled with the seed; nitrate of soda has also been used occasionally as a top dressing in the spring, particularly after an unusually severe winter.

As this farm has been thoroughly and carefully tilled, its productiveness has steadily increased under the above treatment, and it now affords a good example of land in first-class condition for staple crops. When a farm has been managed in this way for a number of years many questions arise regarding the use of commercial fertilizers, which can be answered only by actual experiments. The following will serve as examples:

I. In its effects upon staple crops, how does a complete fertilizer compare with barn-yard manure?

II. Can artificial fertilizers be used profitably upon corn, oats, wheat and grass?

An experiment was begun in 1883 for the purpose of studying these questions. A level field was selected which had been in grass during the two preceding years; it had previously passed through the usual rotation of corn, oats and wheat, and, therefore, had been heavily manured in 1878 and 1880.

Eleven plots, each one-tenth of an acre in area, were staked out near the center of this field. Two of these plots, Nos. 1 and 6, were cropped without the addition of plant-food of any kind. Of the remaining nine plots no two were fertilized alike, but in all other respects their treatment was identical.

The following table will show the kind and quantity of material used in each case—for instance, in 1883 plot 11 was dressed with stable manure at the rate of twenty tons per acre, and a corn crop was planted. In 1884 the same plot was again manured at the same rate, and oats were sown. In 1885 twenty tons of manure per acre were spread upon this plot for the third time, immediately before the wheat was drilled, but the grass, mown in 1886, was not top dressed, and, consequently, drew upon the surplus plant-food left in the soil by the preceding crops. Sixty tons of stable manure per acre was, therefore, used upon this plot in raising the crops of one rotation.

In the same manner, *six hundred and forty* pounds of a commercial fertilizer per acre was sown broadcast each year upon plot 9; its four crops received in all nearly one ton of a very high grade ammoniated superphosphate. The returns in each case were as follows:

	FERTILIZERS.		CORN. 1883.		OATS. 1884.		WHEAT. 1885.		HAY. 1886.
Number of Plot.	Kind.	Weight per Acre Used in 1883, 1884 and 1885.	Bushels of Shelled Corn per Acre.	Pounds of Stalks per Acre.	Bushels of Oats per Acre.	Pounds of Straw per Acre.	Bushels of Wheat per Acre.	Pounds of Straw per Acre.	Pounds of Hay per Acre.
1	Nothing	....	63.9	4,500	42.0	1,540	18.1	960	3,300
2	Nitrate of Soda	150 lbs.	62.5	4,000	49.6	2,210	18.3	1,100	3,300
3	Superphosphate	350 lbs.	62.5	4,200	44.7	1,560	18.2	1,110	3,800
4	Muriate of Potash	150 lbs.	65.3	4,600	47.3	1,580	13.4	800	4,400
5	Nitrate of Soda Superphosphate	150 350 } lbs.	69.4	4,050	66.7	2,400	20.7	1,490	4,600
6	Nothing	....	64.5	3,700	60.7	1,880	10.8	550	3,500
7	Nitrate of Soda Muriate of Potash	150 150 } lbs.	73.6	4,300	71.3	2,610	14.6	920	4,520
8	Superphosphate Muriate of Potash	350 150 } lbs.	71.0	4,600	65.3	2,140	18.2	960	4,420
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 } lbs. 150	73.6	4,600	71.5	2,525	23.0	1,240	4,540
10	Plaster	400 lbs.	63.9	3,800	59.8	2,160	7.7	500	3,340
11	Fine Barn-yard Manure	20 2-horse loads.....	70.8	4,400	66.2	2,720	22.2	1,720	7,140

I.

In its Effects upon Corn, Oats, Wheat and Grass, How does a Complete Fertilizer Compare with Barn-yard Manure?

The complete fertilizer used in this trial was made by mixing nitrate of soda, bone black, superphosphate and muriate of potash in such proportions that the product analyzed nitrogen, 3.7 per cent.; soluble phosphoric acid, 8.60 per cent.; potash, 11.50 per cent. It, therefore, compares favorably with the so-called potato and corn manures offered for sale by the leading manufacturers.

As has been already stated, this fertilizer was used upon plot 9 each year, at the rate of six hundred and forty pounds per acre. The table shows that the crops of *corn, corn stalks, oats* and *wheat* grown with its assistance in each case exceeded similar crops from plot 11, upon which barn-yard manure was used. The crops of *oat straw, wheat straw* and *mixed hay*, from plot 9, were in each case, however, lighter than those from plot 11. Practically, however, the hay crop is the only one in the rotation upon which the superiority of the yard manure is decidedly noticeable, its yield, three and one-half tons per acre of well-cured timothy and clover, being one ton and a quarter heavier than that from the complete fertilizer plot, and nearly two tons per acre heavier than that from the unmanured ground.

II.

Can Commercial Fertilizers be used with Profit upon Corn, Oats, Wheat and Grass?

The cash value of the crops has been computed upon the basis of the market prices which ruled each year at the harvest time. The total cash value of the products gathered from each plot during the rotation is given in one of the last columns of the following table. The total expense for fertilizers is also given.

Number of Plot.	FERTILIZERS.	VALUE OF CROP.				Value of Four Crops.	Cost of Fertilizers for Four Crops.
	Kind.	1883. Corn.	1884. Oats.	1885. Wheat.	1886. Hay.		
1	Nothing	$48.65	$17.22	$18.69	$21.45	$107.01	....
2	Nitrate of Soda	46.38	21.51	19.22	21.45	108.56	$12.15
3	Superphosphate	46.98	18.09	19.16	24.70	108.93	11.01
4	Muriate of Potash	49.72	18.93	14.06	28.60	111.31	9.00
5	Nitrate of Soda Superphosphate	50.32	27.21	22.36	29.90	129.79	23.16
6	Nothing	46.58	23.85	11.10	22.75	104.28	....
7	Nitrate of Soda Muriate of Potash	53.38	29.22	15.44	29.38	127.42	21.15
8	Superphosphate Muriate of Potash	52.85	26.01	19.68	28.73	127.27	20.01
9	Nitrate of Soda Superphosphate Muriate of Potash	54.28	29.03	23.80	29.51	136.62	32.16
10	Plaster	46.55	24.42	8.18	21.71	100.86	4.50
11	Fine Barn-yard Manure	52.14	28.02	24.28	46.41	150.85	90.00

Plots 1 and 6 were cultivated without the addition of fertilizers. Their total product for the entire rotation averaged $105.70 per acre.

The increased crops from plots 5, 7 and 8 were worth enough to pay the cost of the fertilizer, but the balance remaining was then too small to warrant the use, in general farming, of either of these mixtures. For instance, the cash value of the total product from plot 8 was $127.27 per acre; as the unmanured land yielded $105.70 per acre, it leaves $21.57 with which to meet fertilizer bills amounting to $20. This is the most favorable return indicated by this experiment. With the exception of the three plots above mentioned, there are no cases in which the increased yields are valuable enough to pay the expenses incurred for the plant-food used. *No combination of commercial fertilizers, therefore, has been profitably employed in this rotation.*

Plot 11 offers a most striking example of the long investments which farmers are obliged to make. The total returns from this plot were $150.85 per acre, or an advance of $45.15 over that from the unmanured ground. This advance was secured by the use of $90 worth of manure, consequently if the next year's crop of timothy is as valuable as the last year's crop of mixed hay, the cost of the manure will be recovered and the profits will exist solely in the fact that the farmer has succeeded in utilizing *sixty tons* of stable manure per acre in a manner which admits of returns equivalent to $1.50 per ton. Under these conditions, therefore, the transaction is business-like only when the farm itself produces this manure at a profit, that is, when meat and milk production is made to pay, without estimating the value of waste products.

In the above experiment there are two conditions which may have exercised undue influence upon the results:

I. Inequalities in the soil.
II. The excessive amounts of fertilizers used.

I.

INEQUALITIES IN THE SOIL.

The assumption was that two unmanured plots would indicate fairly what the soil alone was able to produce. Upon corn and hay the yields from these plots were practically identical, but in the case of oats, plot 6 appeared to be much richer than plot 1, while the next year's wheat crop indicated that plot 1 was richer than plot 6. The need of much more careful study regarding the uniformity of experimental fields was apparent, and a second rotation was, therefore, begun in 1886. This trial included eighteen plots, each one-twentieth of an acre in area, alternate plots only being fertilized with the kinds and quantities of plant-food used in the former experiment. Each fertilized plot, therefore, lies between two unmanured spaces, and far more reliable comparisons as to the effects of plant-food can therefore be drawn from their crops.

II.

THE EXCESSIVE AMOUNTS OF FERTILIZERS USED.

It is an extremely difficult matter to determine the quantity of plant-food which can be profitably employed. If a failure follows the use of the amounts recognized in ordinary farming, then critics claim that the first hundredweight rarely pays for itself, that profits are generally found in the second. If, on the other hand, unusually large amounts are spread, they point to the increased crops and suggest that the same gains might have followed had the amount of the fertilizer been reduced one-half.

In the experiments reported above, the practice of successful farmers was followed to a certain extent; manure and fertilizers were freely used upon corn and wheat—the grass crops, however, were expected to thrive upon the surplus plant-food remaining in the soil from previous dressings. Contrary to this practice, the oats were fertilized as heavily as either of the other grain crops, and expenses were thereby increased by at least thirty-three per cent.

In the rotation begun last spring the corn was manured and fertilized as usual. Wheat will also be treated in a similar manner, but the oats will not be fertilized in any way. It is possible, therefore, that this reduction in expenses and a more correct comparison of the products from the fertilized and unfertilized plots may modify or change the present opinion that the staple crops of this farm do not respond profitably to the use of commercial manures.

Temperature and rainfall exert, of course, a very marked influence upon crop development, and must be duly weighed in comparing the results of the old and new rotation. The following observations are therefore recorded for future use:

MONTHLY RECORD OF THE MEAN TEMPERATURE AND AVERAGE RAINFALL, AT NEW BRUNSWICK, FOR 1883, 1884, 1885 AND 1886.

	MEAN TEMPERATURES.				AVERAGE RAINFALL.			
	1883.	1884.	1885.	1886.	1883.	1884.	1885.	1886.
	Deg.	Deg.	Deg.	Deg.	Inches.	Inches.	Inches.	Inches.
January	24.9	24.2	30.7	25.3	3.71	5.63	3.72	4.30
February	28.2	35.7	21.3	28.5	4.67	5.28	4.93	5.03
March	29.6	36.8	29.8	36.3	1.96	4.23	1.08	3.92
April	41.4	47.2	47.7	50.0	4.03	2.20	2.14	3.53
May	54.5	60.8	56.5	58.2	2.82	3.17	2.01	5.30
June	69.6	66.0	67.9	65.6	5.24	5.34	1.67	4.65
July	70.7	70.9	79.5	72.3	3.44	4.80	4.29	4.26
August	67.0	71.7	69.8	70.1	4.40	5.03	5.30	2.51
September	62.1	67.9	62.7	66.0	3.35	0.37	0.80	1.23
October	54.3	55.4	55.3	54.7	4.29	3.16	4.00	2.28
November	47.1	41.1	39.8	43.1	1.49	3.60	4.04	3.98
December	....	33.0	33.9	....	....	....	....	....

FIELD EXPERIMENTS WITH FERTILIZERS ON CORN.

BY THEODORE WEST, COLLEGE FARM, NEW BRUNSWICK, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.		
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Ears.	Bushels of Shelled Corn.	Pounds of Stalks.
1	Nitrate of Soda	160 lbs.	$4.32	4,900	61.3	5,120
	No Fertilizer			4,000	50.0	4,800
2	Superphosphate	300 lbs.	3.20	3,680	46.0	5,200
	No Fertilizer			3,900	48.8	4,600
3	Muriate of Potash	150 lbs.	3.00	4,040	50.5	5,600
	No Fertilizer			3,760	47.0	4,660
4	Nitrate of Soda, 160 Superphosphate, 300	460 lbs.	7.52	4,260	53.3	5,200
	No Fertilizer			3,680	46.0	5,000
5	Nitrate of Soda, 160 Muriate of Potash, 150	310 lbs.	7.32	4,420	55.3	6,000
	No Fertilizer			3,320	41.5	5,200
6	Superphosphate, 300 Muriate of Potash, 150	450 lbs.	6.20	3,300	41.3	5,600
	No Fertilizer			3,500	43.8	4,700
7	Nitrate of Soda, 160 Superphosphate, 300 Muriate of Potash, 150	610 lbs.	10.52	4,160	52.0	6,000
	No Fertilizer			3,360	42.0	5,200
8	Plaster	400 lbs.	1.50	3,140	39.3	5,300
	No Fertilizer			3,080	38.5	5,400
9	No Fertilizer			3,080	38.5	5,460
	Fine Barn-yard Manure	20 tons.	30.00	5,460	68.3	6,400

This experiment begins a rotation which has been planned to show:

I. The variations in yields between unmanured plots;

II. The effects both of barn-yard manure and commercial fertilizers upon the growth of corn, oats, wheat and grass.

The above plots are located in the center of a field which was cropped, in 1882, with fodder corn, grown with a heavy dressing of barn-yard manure. Since that time, without the addition of plant-food of any kind, it has yielded heavy crops of rye, clover and mixed hay.

The season was unfavorable for corn, the rainfall in May being *five inches,* in comparison with two and seven-tenths inches, the average for this month for the years 1883, 1884, 1885. This caused late planting on many farms, and, in consequence, the crops fell considerably below the average.

I.

THE VARIATIONS IN YIELDS FROM UNMANURED PLOTS.

In comparing the yields from the unmanured plots, it is evident that marked differences in fertility must exist, for plot 9 produced twelve bushels of shelled corn per acre less than plot 1. This decline in fertility, however, appears to be regular and gradual, for, when neighboring plots are compared, their differences in yield are seen to be easily within the range of experimental errors.

It has been noticed, in a former experiment, that the two unfertilized plots hitherto employed agreed very closely in their yields of corn and clover hay, but differed from each other widely in their crops of oats and wheat, without apparent cause. It is hoped, therefore, that the above experiment, when carried through its rotation, will aid in disclosing a reason for such differences and thereby increase the confidence felt in this branch of field work.

II.

THE EFFECTS OF COMMERCIAL FERTILIZERS UPON INDIAN CORN.

Nitrogen has this year been the most efficient element in the development of grain, its most favorable returns resulting from its combination with potash.

Phosphoric acid, when used either alone or in combinations, has exercised unfavorable effects upon the grain development. Alone it reduced the yield below that from its unfertilized plots, and in combination its yields were less than the other elements produced without its aid. The largest return, viz., thirty bushels of shelled corn per acre, was caused by the barn-yard manure.

Of all of the elements, potash influences stalk development most favorably, and, when used alone, its yields excel those from its combinations. In this work, phosphoric acid stands next to potash, and nitrogen ranks lowest.

FIELD EXPERIMENTS BY MR. A. P. ARNOLD,

VINELAND, CUMBERLAND COUNTY.

The soil of this farm is a very sandy loam easily tilled, responsive to fertilizers and especially suitable for the cultivation of sweet potatoes, berries and small fruits in general. Dairying is not followed to any extent, and relatively little live stock is kept, consequently the supply of yard manure is limited. Commercial fertilizers are recognized as necessities and are used as freely as good management will warrant.

Mr. Arnold and his neighbors have been busily engaged for many years in studying the fertilizer markets and testing their own farms with various mixtures. At present, potash salts and acid phosphates are regarded with more favor than the ordinary brands of complete fertilizers.

In 1882 this Station offered its assistance in carrying out field trials to determine:

I. The effect of barn-yard manure upon a rotation of crops compared with the effects of the leading elements of plant-food used separately and in combinations.

II. The financial results which follow the use of commercial fertilizers.

The field selected for this work was, at that time, in blackberries. It was prepared for corn in the usual manner, and eleven plots, each one-tenth of an acre in area, were staked off in a favorable location. The kinds and quantities of plant-food used in 1882 upon each plot can be learned from a following table. During the succeeding years of the rotation every crop was fertilized, but no changes of any kind were made in the original plan. Plot 11, therefore, received in all *eighty tons* of stable manure per acre. In like manner, plot 4 received *six hundred pounds* of muriate of potash, plot 3 *fourteen hundred pounds* of bone-black superphosphate, plot 9 twenty-six hundred pounds of a high-grade potato fertilizer per acre, &c., in each case one-quarter of the above weights having been used broadcast annually. The crop returns were as follows:

Number of Plot.	FERTILIZERS.		YIELD PER ACRE.							
	Kind.	Weight per Acre Used Annually in 1882, 1883, 1884 and 1885.	1882.		1883.		1884.	1885.		
			Corn.		Sweet Potatoes.		Clover and Millet.	Clover Hay.		
			Bushels of Shelled Corn.	Pounds of Stalks.	No. of Bushels Good.	No. of Bushels Poor.	Pounds.	Pounds. First Cut.	Pounds. Second Cut.	Total Weight.
1	Nothing..............	....	15.8	1,450	25.0	33.4	910	440	210	650
2	Nitrate of Soda.......	150 lbs.	22.7	1,540	25.8	30.2	2,010	450	210	660
3	Superphosphate......	350 lbs.	15.0	1,560	29.4	37.4	1,030	680	420	1,100
4	Muriate of Potash...	150 lbs.	13.7	1,500	72.8	21.8	1,020	810	430	1,240
5	Nitrate of Soda....... Superphosphate......	150 350 } lbs.	20.7	1,820	32.0	32.8	2,210	1,070	440	1,510
6	Nothing..............	....	11.7	1,480	30.6	30.6	970	460	120	580
7	Nitrate of Soda....... Muriate of Potash...	150 150 } lbs.	25.1	1,600	65.0	28.6	2,430	760	330	1,090
8	Superphosphate...... Muriate of Potash...	350 150 } lbs.	14.4	1,630	80.6	37.2	1,200	1,530	620	2,150
9	Nitrate of Soda....... Superphosphate...... Muriate of Potash...	150 350 } lbs. 150	23.1	1,680	92.8	43.2	3,280	1,680	740	2,420
10	Plaster..............	400 lbs.	13.8	1,380	16.4	34.4	1,070	390	390	780
11	Fine Barn-yard Manure..........	20 2-horse loads....	24.5	1,800	108.0	35.4	3,580	3,160	2,360	5,520

I.

The Effects Upon Crop Development of the Leading Elements of Plant-Food, when Used Separately and in Combination, Compared with the Effects of Barn-yard Manure.

Nitrate of soda exercised most marked effects upon corn and millet; practically it was valueless upon potatoes and clover. The superphosphate influenced the growth of clover noticeably, a result probably due largely to its phosphoric acid, for its other leading ingredient, viz., land plaster, when used alone upon plot 9, in no case indicated favorable action. The superphosphate yielded no returns when used on corn, potatoes and millet. Potash was the controlling element upon potatoes and clover; it was also without effect upon the growth of corn and millet.

The above-mentioned effects of these elements, when used singly, are also marked in their combinations; in every case, save one, the largest crops were secured by using the complete manure. (See plot 9.) Without exception, the crops from this plot were surpassed by those from plot No. 11. The yields of corn, potatoes and millet from plot 11 indicate a nominal superiority only of barn-yard manure, but the returns on clover prove that with its aid this light soil can produce 5,520 pounds of hay per acre, in comparison with 2,420 pounds, the yield from the complete fertilizer; it shows, too (compare plots 11 and 6), that the stable manure increased the hay crop nearly ten-fold; this was done, however, at a very considerable outlay. The discussion of the financial returns will be aided by the following table:

Number of Plot.	FERTILIZERS.	VALUE OF CROP.				Value of Four Crops.	Cost of Fertilizers for Four Crops.
	Kind.	1882. Corn.	1883. Sweet Potatoes.	1884. Clover and Millet.	1885. Clover.		
1	Nothing	$16.14	$25.85	$9.10	$3.90	$54.99	....
2	Nitrate of Soda	21.28	25.61	20.10	3.96	70.95	$16.20
3	Superphosphate	15.96	29.93	10.60	6.60	63.09	14.68
4	Muriate of Potash	14.84	56.41	10.20	7.44	88.89	12.00
5	Nitrate of Soda Superphosphate	20.86	30.60	22.10	9.06	82.62	30.88
6	Nothing	13.37	29.07	9.70	3.48	55.62	....
7	Nitrate of Soda Muriate of Potash	23.17	52.65	24.30	6.54	106.66	28.20
8	Superphosphate Muriate of Potash	15.79	65.77	12.00	12.90	106.46	26.68
9	Nitrate of Soda Superphosphate Muriate of Potash	22.05	75.76	32.80	14.52	145.13	42.80
10	Plaster	14.49	20.08	10.70	4.68	49.95	6.00
11	Fine Barn-yard Manure	23.45	85.45	35.80	33.12	177.82	120.00

II.

The Financial Results which Follow the Use of Commercial Fertilizers.

The above calculations are based upon the market prices which ruled at the time these crops were ready for sale. The total cash values of the products from the unmanured plots (1 and 6) agree closely, and average $55.30 per acre.

The increased crops due to nitrate of soda returned the amount invested for this salt, but left no balance. Potash influenced the profits in a very marked manner; the increased returns from its use were sufficient to leave a balance of $21.59 after fertilizer charges had been met and due credit allowed for the product from the unmanured ground. *$21.59 is one hundred and eighty per cent. of $12.00, the cost of 600 lbs. of muriate of potash.*

Plots 7 and 8, upon which potash was used in combination with nitrogen and phosphoric acid, respectively, also gave profitable crops, the net gains being $23.16 in one case and $24.48 in the other. The combination of nitrogen, phosphoric acid and potash (plot 9) called for the largest investment but yielded the largest net profit, viz., $47.03, *or one hundred and ten per cent. of $42.80, the market value of twenty-six hundred pounds of a complete potato manure.*

An examination of the above table will indicate that the sweet potato crop was the principal source of the above profits, for the returns from the corn and millet did not pay for the potash salt, and the total value of the clover hay produced upon plot 4 would offer no inducement whatever, in general farming, to expend the time and money necessary to secure it. Combinations of potash, both with nitrogen and with phosphoric acid, when used upon corn and millet in one case, and upon clover hay in the other case, indicate results which might be called favorable were it not evident that the potato crop gave much more desirable returns. From one standpoint it may safely be claimed that all other crops in this rotation served merely as agents for holding the soil in suitable condition for the cultivation of sweet potatoes.

During a period of four years, Mr. Arnold used eighty tons of stable manure per acre, upon plot 11, and converted it into crops worth $177.82. During the same period, without the aid of fertilizers, a portion of the same field in the same crops, gave returns worth $55.30. The value of the manure may therefore be estimated at $122.52, or a fraction more than *one dollar and fifty cents per ton.* The manure, of course, caused a marked improvement in the fertility of the field, but the value of this improvement cannot at present be definitely expressed. To study this point, a second rotation has been commenced upon the same plots, its first crop, Indian corn, having been gathered in 1886 with the following results:

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.				
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Ears Good.	Pounds of Ears Poor.	Bushels of Shelled Corn Good.	Bushels of Shelled Corn Poor.	Pounds of Stalks.
1	Nothing			840	90	11.2	0.9	2,770
2	Nitrate of Soda	150 lbs.	$4 05	1,310	190	17.5	1.9	2,840
3	Superphosphate	350 lbs.	3 67	930	210	12.4	2.1	3,990
4	Muriate of Potash	150 lbs.	3 00	940	170	12.5	1.7	4,140
5	Nitrate of Soda Superphosphate	150 350 } 500 lbs.	7 72	2,100	180	28.1	1.8	4,190
6	Nothing			970	220	13.0	2.2	3,050
7	Nitrate of Soda Muriate of Potash	150 150 } 300 lbs.	7 05	1,650	300	22.0	3.0	3,980
8	Superphosphate Muriate of Potash	150 350 } 500 lbs.	6 67	860	180	11.5	1.8	5,460
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 } 650 lbs. 150	10 72	2,290	170	30.5	1.7	5,370
10	Plaster	400 lbs.	1 50	500	170	6.6	1.7	2,560
11	Fine Barn-yard Manure	20 2-horse loads.	30 00	3,410	120	45.5	1.2	5,440

During the past five years each plot in the above experiment has been dressed five times with the kind and quantity of fertilizer noted in the above table. Per acre, therefore, plot 11 has received one hundred tons of stable manure; plot 9 has received 3,150 pounds of a high-grade potato or corn fertilizer, and plot 3 has received 1,750 pounds of a plain superphosphate.

This is the second corn crop grown upon these experimental plots—the first having been harvested in 1882.

Nitrogen seems to have controlled the *grain development*, potash and phosphoric acid having been of little value when used either above or combined, but noticeable improvements in yields, in each case, followed their combination with nitrogen. The largest returns came from the stable manure, plot No. 11.

Nitrogen had but little effect upon stalk growth, in its influence in this direction being noticeably surpassed by both potash and phosphoric acid; plot 8, upon which these two elements of plant-food were used together, giving, without exception, the heaviest crop.

These results are practically identical with those from the College Farm experiment on corn, for 1886. Nitrogen, in this case, was also the ruling element in grain production, and of no practical value in increasing the weight of stalks.

The statement has been already made that the second rotation upon Mr. Arnold's plots was planned in the expectation that it would afford definite information regarding the storage of plant-food in the soil, one of the leading arguments in favor of using large amounts of manure and complete fertilizers being their effects upon subsequent crops. A comparison of the corn yield for 1882 with that for 1886 can now be drawn from the following tabulation. It is expected that the monthly record of mean temperatures and average rainfall for Vineland, since 1882, will be available for the next annual report:

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.			
	Kind.	Weight per Acre Used Annually in 1882, 1883, 1884, 1885 and 1886.	Annual Cost per Acre.	Bushels of Shelled Corn, 1882.	Bushels of Shelled Corn, 1886.	Pounds of Stalks, 1882.	Pounds of Stalks, 1886.
1	Nothing	....	....	15.8	12.1	1,450	2,770
2	Nitrate of Soda	150 lbs.	$4 05	22.7	19.4	1,540	2,840
3	Superphosphate	350 lbs.	3 67	15.0	14.5	1,560	3,990
4	Muriate of Potash	150 lbs.	3 00	13.7	14.2	1,500	4,140
5	Nitrate of Soda Superphosphate	150 350 lbs.	7 72	20.7	29.9	1,820	4,190
6	Nothing	....	....	11.7	15.2	1,480	3,050
7	Nitrate of Soda Muriate of Potash	150 150 lbs.	7 00	25.1	25.0	1,600	3,980
8	Superphosphate Muriate of Potash	350 150 lbs.	6 67	14.4	13.3	1,630	5,460
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 lbs. 150	10 72	23.1	32.2	1,680	5,370
10	Plaster	400 lbs.	1 50	13.8	8.3	1,380	2,560
11	Fine Barn-yard Manure	20 2-horse loads.	30 00	24.5	46.7	1,800	5,440

The crops of shelled corn grown in 1886 upon plots 11, 9 and 5, are considerably larger than those gathered from the same plots in 1882: the increase being 90 per cent. for plot 11, 28 per cent. for plot 9, and 44 per cent. for plot 5. In all other cases, excepting plot 10, the yields for 1882 and 1886 are practically identical.

The influence of the weather upon these results is at present unknown, and further comparisons will therefore be postponed.

FIELD TRIALS WITH CANADIAN ASHES, DOMESTIC ASHES, DISSOLVED SOUTH CAROLINA ROCK AND ORCHILLA GUANO.

BY A. P. ARNOLD, VINELAND.

	FERTILIZERS.			YIELD PER ACRE.							
				1885. Clover.			1886. Corn.				
Number of Plot.	Kind.	Amount per Acre.	Cost per Acre.	Pounds. First Cut.	Pounds. Second Cut.	Total Weight.	Pounds of Ears, Good.	Pounds of Ears, Poor.	Bushels of Shelled Corn, Good.	Bushels of Shelled Corn, Poor.	Pounds of Stalks.
A	Canada Ashes.......	100 bu.	$36 00	1,380	1,360	2,740	2,760	90	36.8	0.9	6,020
B	Home Ashes.........	100 bu.	....	1,240	940	2,180	2,780	80	37.0	0.8	5,560
C	Dissolv. S. C. Rock..	1,000 lbs	10 00	2,120	740	2,860	2,740	100	36.5	1.0	4,680
D	Orchilla Guano......	1,000 lbs	12 50	2,110	590	2,700	2,650	120	35.3	1.2	4,960

The above experiment was planned by Mr. Arnold, and will be carried through the rotation. The corn crop was not directly fertilized, but was grown upon the clover sod.

The above entries are made as a record simply, the consideration of the plan and its results being deferred until the trial is completed.

FIELD EXPERIMENTS WITH WOOL WASTE UPON WHEAT AND CLOVER.

BY THEO. WEST, COLLEGE FARM, NEW BRUNSWICK.

The primary object of this experiment, begun in the fall of 1883, was to determine the value of wool waste as a fertilizer for wheat.

In order to render the nitrogen of the wool waste more readily available, caustic potash was used as a solvent; but the experiment was so planned that the true effect of the caustic was not definitely proven. In 1884 the experiment upon wheat was planned to allow of a study of the following questions:

1. The effect upon crop development of nitrogen in wool waste.
2. The effect of caustic potash in improving the quality of nitrogen in wool waste.
3. The relative effect upon wheat of caustic potash, phosphoric acid, and of nitrogen from wool waste.

The conclusions were as follows:

1. Favorable results were secured by the use of wool waste.
2. The nitrogen of the wool waste was not increased in value by the treatment with caustic potash.
3. Both nitrogen and phosphoric acid exercised favorable effects upon the growth of wheat.
4. Potash, while it increased the weight of straw, did not in any way affect the yield of grain.

The experiment this year upon clover is a study of the continued effect, under the same conditions, of the fertilizers applied upon wheat in the fall of 1884.

The plots were 12 feet wide and 363 feet deep—in area, therefore, one-tenth of an acre.

The dividing lines, or spaces between plots, were approximately 18 inches wide.

The yields for 1885 and 1886, together with the details of the experiment, are tabulated in the following table:

FIELD EXPERIMENTS WITH WOOL WASTE UPON WHEAT AND GRASS.

COLLEGE FARM, 1885, 1886.

Number of Plot.	FERTILIZERS.		Method of Application.	YIELD PER ACRE.		
	Kind.	Amount per Acre.		1885. Wheat.		1886. Hay.
				Pounds of Wheat.	Pounds of Straw.	Pounds of Hay.
1	Nothing...........................	....	....	945	855	4,480
2	Caustic Potash.................	900 lbs.	Dissolve in water, mixed with coal ashes, and broadcasted.	955	1,645	6,830
3	Wool Waste......................	2,000 lbs.	Mixed with coal ashes and applied broadcast.	1,330	1,370	6,050
4	Caustic Potash............. Wool Waste..................	900 lbs. 2,000 lbs.	Caustic allowed to act in solution on wool waste for ten days, then mixed with ashes; applied broadcast.	1,350	1,500	6,234
5	Caustic Potash............. Wool Waste..................	900 lbs. 2,000 lbs.	Caustic dissolved in water. mixed with coal ashes and applied broadcast. Wool waste mixed with coal ashes and applied broadcast one day later.	1,610	2,240	6,417
6	Caustic Potash............. Wool Waste.................. Bone-Black Superphosphate.........................	900 lbs. 2,000 lbs. 350 lbs.	Caustic dissolved and soaked into wool waste and applied broadcast, superphosphate drilled with the seed.	1,480	1,620	7,516
7	Caustic Potash............. Wool Waste.................. Bone-Black Superphosphate.........................	900 lbs. 2,000 lbs. 350 lbs.	Wool waste and superphosphate applied one day later than caustic.	1,540	2,060	7,176
8	Caustic Potash............. Sulphate of Ammonia.. Bone-Black Superphosphate.........................	900 lbs. 700 lbs. 350 lbs.	Ammonium sulphate and superphosphate applied one day later than caustic.	1,620	2,630	5,592
9	Wool Waste.................. Bone-Black Superphosphate.........................	2,000 lbs. 350 lbs.	Wool waste mixed with coal ashes and applied broadcast, the superphosphate drilled with the seed.	1,680	1,820	6,600
10	Caustic Potash............. Bone-Black Superphosphate.........................	900 lbs. 350 lbs.	Caustic dissolved in water, mixed with coal ashes and applied broadcast, superphosphate drilled with the seed.	1,350	1,750	6,234
11	Bone-Black Superphosphate.........................	350 lbs.	Drilled with the seed.	1,580	1,820	5,592

The Effect of Nitrogen in Wool Waste upon Clover.

A comparison of plots 3 and 1 shows that wool waste alone has increased the yield of clover 1,570 pounds; in combination with phosphoric acid, a still larger increase is produced, while in the complete manure the increase reaches 2,700 pounds.

The Effect of Caustic Potash in Improving the Quality of the Nitrogen in Wool Waste.

The yields from 4, 5, 6 and 7 show a slight increase in favor of the untreated waste on No. 5, and an increase in favor of the treated waste on No. 6.

If the caustic potash has been of any service in rendering the nitrogen of the wool waste more readily available, this service is too small to pay the cost of the treatment.

The Relative Effects of Caustic Potash, Phosphoric Acid and Nitrogen from Wool Waste upon the Growth of Clover.

Potash seems to have had the most marked effect of any of the ingredients when used singly; wool waste was also effective in securing an increase in excess of that from phosphoric acid.

A yield in proportion to the increase, when used singly, is not secured when the different fertilizers are used in combination upon plots 6 and 7.

The results from these experiments show that wool waste, at the price at which this was secured, furnishes a very cheap source of nitrogen for these crops.

As the caustic potash had no favorable effect upon the nitrogen in the wool waste, its value depends entirely upon the amount of actual potash it contains; kainite or muriate of potash furnishes this element at a much cheaper rate.

FIELD TRIALS UPON INDIAN CORN, WHEAT AND RYE.

MADE TO TEST AND COMPARE

Various Forms of "Available" Phosphoric Acid.

The object and plan of the following experiments were given in detail in the last Annual Report of this Station, from which the following is quoted: "Agricultural chemists in the United States have recognized, for many years past, three distinct classes of phosphates:

"*First*—Those which dissolve in water.

"*Second*—Those which dissolve in neutral solutions of citrate of ammonia at temperatures not exceeding 100° Fahr.

"*Third*—Those which are insoluble in both of the above-named fluids.

"The phosphates included in the first and second classes are known to be of agricultural value whenever they are properly used upon suitable soils. Regarding those in the third class, however, it has been assumed until recently that their agricultural value was too low to be worthy of notice.

"Several years ago, at a convention held in Atlanta, Ga., a large number of chemists from different States created a fourth class, by isolating from the third all phosphates which dissolve in neutral solutions of citrate of ammonia at temperatures ranging between 100° and 150° Fahr. By adopting this test it was tacitly understood that phosphates which respond to it should rank with those in the first and second classes."

This change in an analytical method admitted the iron and alumina phosphates into the fertilizer trade.

The advantages promised by it were those which would naturally follow a very large increase in the supply of any product; its danger lies in grading a material higher than available facts justified.

The use of citrate of ammonia, at 150° Fahr., as a solvent in the analyses of phosphates, is illegal in New Jersey. Some dealers claim that serviceable brands are thereby either seriously depreciated in market value or even excluded from this trade. They therefore urge that this law should be repealed. This Station's officials believe that the matter should be investigated, and they have, therefore, carried out numerous field trials to determine the agricultural value of each of the four above-mentioned forms of phosphoric acid.

The materials used have been bone-black superphosphate, precipitated phosphate of lime, phosphoral and floats. Three of these are familiar commercial products; the following description of the fourth, viz., phosphoral, is reprinted from the last report:

"Phosphoral is a fertilizer containing neither nitrogen nor potash. It is made from iron and alumina phosphates by the action of sulphur and heat; the use of sulphuric acid or oil of vitriol being entirely avoided in its preparation.

"The Tropic Guano Company, of New York City, donated nearly fifteen hundred pounds of this product to be used by this Station in field trials upon corn, turnips, wheat and rye.

"Its analysis, as copied from page 31 of Report for 1886, is as follows:

Phosphoric Acid.	Phosphoric Acid.	Phosphoric Acid.	Phosphoric Acid.
Total.	Soluble in water.	Soluble in citrate of ammonia at 100° Fahr.	Soluble in citrate of ammonia at 150° Fahr.
Per cent.	Per cent.	Per cent.	Per cent.
49.40	......	4.61	32.65

"With less than five per cent. of phosphoric acid soluble at 100° Fahr., and with nearly thirty-three per cent. soluble at 150° Fahr., phosphoral furnishes a striking illustration of a phosphate stamped 'worthless' by one test and 'valuable' by a second; the difference between the tests lying solely in the temperature employed."

Water dissolves practically all of the phosphoric acid in bone-black superphosphate, but it has no solvent action upon the phosphoric acid, either in floats, in phosphoral or in precipitated calcium phosphate. *The bone-black superphosphates therefore represent the first class.*

Citrate of ammonia solution, at 100° Fahr., dissolves practically all of the phosphoric acid in precipitated calcium phosphates, and has trifling solvent action only upon the phosphates in phosphoral and in floats. *The precipitated calcium phosphates represent the second class.*

Citrate of ammonia solution, at 150° Fahr., dissolves a very large percentage of the total phosphoric acid from phosphoral, and a small percentage only from floats. *Phosphoral, therefore, may be taken as a representative of the class created by the Atlanta Convention*, while floats represent those phosphates which dissolve neither in water nor in citrate of ammonia at recognized temperatures.

Experiments have already demonstrated that soluble phosphoric acid is not always the form from which the highest agricultural results are secured, and cases are not wanting where positive assertions have been made regarding the profits which follow the use of the insoluble phosphoric acid in floats. Enough, therefore, is known to warrant the labor and expense involved in the following trials.

LOCATIONS OF EXPERIMENTS AND DESCRIPTIONS OF SOILS.

The farm of Arnold & Stephens is situated in Warren county, on the drained lands of the Pequest. The soil is a black muck, three feet deep, overlying sand. It was a fresh marsh until within the last two or three years. The hills adjacent are mostly of gneiss with a little limestone; a small portion of soil from these may have been washed down and deposited in this marsh. The muck is, however, almost all organic matter, and, when dry, burns freely.

The soil upon the College farm, near New Brunswick, consists largely of decomposed shale; it has been manured heavily for several years and is in a high state of cultivation.

Mr. Irons' farm lies near Manchester, in Ocean county; its soil is a light and rather fine sand, thin and naturally unproductive. It is very easy of tillage, and when marled and enriched, yields paying crops.

The farm of Mr. J. E. Parmly, near Oceanic, Monmouth county, is situated on the outer edge of the red sand bed of the marl formation. The soil is a sandy loam and is naturally rather deficient in the elements of plant-food, but it is susceptible of the highest degree of improvement by enrichment and cultivation.

The soil upon the farm of Ezra Dayton, Basking Ridge, Somerset county, is a heavy yellow loam, derived from the decomposition of igneous or trap rocks which probably underlie it. It is rather cold, but responds well to fertilization.

Rhutson Case, of Flemington, Hunterdon county, has a red sandstone soil, loamy, not very rich in mineral elements of plant-food, but containing much oxide of iron, and responding generously to fertilization. It is underlaid by red sandstone.

D. F. Pursel's land, near New Village, Warren county, is a yellow loam, a very fine soil, rich in mineral elements and underlaid by limestone.

DETAILS OF EXPERIMENTS.

Before the trials were begun, detailed directions were given to each experimenter. They indicated the conditions to be observed in order to secure uniformity.

Upon each farm there were fourteen plots, each one-tenth of an acre in area. These plots were parallel and separated from each other by middle furrows.

A headland six feet wide was left at each end of each corn plot as a turning space; this was done to avoid injury to the plants at the ends of the rows during cultivation.

All details, relative either to the kind and quantity of fertilizers used or to the weights of the crops harvested, can be learned from the following tables. One explanation, however, may be necessary: the chemical reaction which occurs when bone-black is treated with oil of vitriol, or sulphuric acid, results in the formation of large quantities of plaster; each hundred pounds of the bone-black superphosphate used in these experiments contained nearly fifty pounds of this material, which is not found either in the floats or phosphoral, and is present as traces only in the precipitated calcium phosphate.

The precipitated plaster in bone-black superphosphates doubtless often exerts marked and favorable action upon plant-life, consequently it is necessary to add a corresponding quantity of precipitated plaster to floats, phosphoral and precipitated calcium phosphate, whenever a comparison is attempted between the action of the four abovementioned forms of phosphoric acid.

The precipitated plaster used by this Station was donated in very large quantities by Harrison Brothers, of Philadelphia.

The fertilizers were in all cases mixed with moistened sawdust, then sown broadcast and harrowed in.

WEATHER.

Arnold & Stephens report a cold and rainy spring, and dry fall with early frosts; an unfavorable season for corn. The other experimenters conclude that, all things being taken in consideration, the weather was favorable for grain.

CONSIDERATION OF THE RESULTS.

The results have been arranged in three tables:

TABLE I.

The crop returns from floats, phosphoral and precipitated phosphate of lime may be compared with each other, and with those from corresponding unfertilized plots.

Phosphoric acid, under these conditions, noticeably increased the crops of corn, rye and wheat. The only exception is found on the farm of Mr. Irons; here the results are irregular and their discussion will therefore be postponed.

Floats, in every case but one, failed to increase the crops of corn, rye and wheat.

Phosphoral was serviceable upon corn and rye, but it influenced the wheat crop in one instance only, that being upon the farm of Mr. Case, upon which the floats also offered an exception to their general rule.

Precipitated phosphate of lime caused an increased crop wherever it was used; in every case, too, its yields noticeably surpassed those from phosphoral.

TABLE I.

	Number of Plot.	1	3	4	5
	Fertilizers Used per Acre.	No Fertilizer.	Floats, 250 lbs.	Phosphoral, 185 lbs.	Precipitated Phosphate of Lime, 255 lbs.
	Kind and Quantity of Plant-food per Acre.		Phosphoric Acid Insoluble, 60 lbs.	Phosphoric Acid Available at 150°, 60 lbs. Phosphoric Acid Insoluble, 31.4 lbs.	Phosphoric Acid Available at 100°, 60 lbs. Phosphoric Acid Insoluble, 9.4 lbs.
		lbs.	lbs.	lbs.	lbs.
CORN.					
Arnold & Stephens	Ears of Corn Good.	....	3.220	4,660	5,430
Independence, Warren co	Ears of Corn Poor..	....	550	480	360
	Stalks	....	4,690	5,020	5,890
RYE.					
Theodore West	Grain	2,340	2,310	2,600	3,070
College Farm, Middlesex co	Straw	5,210	4,890	5,170	6,580
WHEAT.					
J. H. Irons	Grain	....	343	208	235
Manchester, Ocean co	Straw	....	540	388	413
J. E. Parmly	Grain	700	670	630	930
Oceanic, Monmouth co	Straw	1,390	1,070	960	1,160
Ezra Dayton	Grain	750	690	730	1,020
Basking Ridge, Somerset co	Straw	1,250	1,140	1,170	2,260
Rhutson Case	Grain	1,010	1,190	1,300	1,510
Flemington, Hunterdon co	Straw	1,080	1,460	1,500	1,790
David F. Pursel	Grain	1,680	1,420	1,460	1,850
New Village, Warren co	Straw	2,590	2,230	2,800	2,770

TABLE II.

Floats, phosphoral and precipitated phosphate of lime were in every case mixed with precipitated sulphate of lime or land plaster. The crops raised with these mixtures may be compared with each other and with the returns from the bone-black superphosphate. The crops from all four phosphates may also be compared with those from corresponding plots, dressed with plaster only.

Phosphates mixed with plaster and used on corn and rye increased the yields over those from plaster alone; when used upon wheat, however, plaster, in three cases, yielded larger returns than the phosphates—a result which demands close investigation.

Floats mixed with plaster was without effect upon corn; upon rye, it indicated a slight increase; upon wheat, in three cases, its crops were smaller than those from plaster alone, and in two cases its increased yields were without practical significance.

Phosphoral, mixed with plaster, was useless upon corn, but upon rye it gave a very favorable result. On wheat, in three cases, its yields were less than plaster alone produced; in one case, it was not quite as serviceable as floats, and in one case it increased the crop by, roughly, three bushels of grain per acre.

Precipitated phosphate of lime, when mixed with plaster, had no marked influence on corn; on rye it caused a very large increase in grain, surpassing all other forms of phosphates; on wheat, in three cases, its crops were surpassed by those from plaster alone. In every case, however, it was noticeably superior to floats and phosphoral, and it was surpassed in one case only by bone-black superphosphate.

Bone-black superphosphate used on corn excelled all other forms of phosphoric acid. On rye it is less serviceable than either phosphoral or precipitated phosphate of lime. On wheat it surpassed floats in every case, and phosphoral in every case save one, in which the results were identical. In one instance it gave larger returns than the precipitated phosphate by, roughly, three bushels of grain per acre. In two cases its crops were practically identical with those from the precipitated phosphate, but in two cases it was clearly of less value agriculturally than this phosphate.

Without exception either bone-black superphosphate or precipitated phosphate of lime has given the largest returns, but the above data are not sufficient to decide that one of these two sources of phosphoric acid is superior to the other.

TABLE II.

Number of Plot.		1	2	6	7	8	9
Fertilizers Used per Acre.		No Fertilizer.	Precipitated Plaster, 180 lbs.	Bone-Black Superphosphate, 340 lbs.	Precipitated Plaster, 180 lbs. Floats, 250 lbs.	Precipitated Plaster, 180 lbs. Phosphoral, 185 lbs.	Precipitated Plaster, 180 lbs. Precipitated Phosphate of Lime, 255 lbs.
Kind and Quantity of Plant-food per Acre.			Sulphate of Lime, 164 lbs.	Phosphoric Acid Soluble, 60 lbs. Sulphate of Lime, 163 lbs.	Sulphate of Lime, 164 lbs. Phosphoric Acid Insoluble, 60 lbs.	Sulphate of Lime, 164 lbs. Phosphoric Acid Available at 150°, 60 lbs. Phos. Acid Insoluble, 31.4 lbs.	Sulphate of Lime, 164 lbs. Phosphoric Acid Available at 100°, 60 lbs. Phos. Acid Insoluble, 9.4 lbs.
CORN.		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Arnold & Stephens	Ears of Corn Good.	....	4,840	5,400	4,090	4,290	4,790
Independence, Warren co	Ears of Corn Poor.	....	430	390	530	440	490
	Stalks	....	5,230	5,870	4,500	4,950	4,850
RYE.							
Theodore West	Grain	2,340	2,270	2,525	2,425	2,720	2,920
College Farm, Middlesex co	Straw	5,210	4,580	5,475	5,525	5,950	5,080
WHEAT.							
J. H. Irons	Grain	....	365	230	143	203	243
Manchester, Ocean co	Straw	....	635	345	273	355	420
J. E. Parmly	Grain	700	1,080	930	560	810	930
Oceanic, Monmouth co	Straw	1,390	2,010	1,230	930	1,350	1,250
Ezra Dayton	Grain	750	720	990	730	870	1,330
Basking Ridge, Somerset co	Straw	1,250	1,180	1,590	1,150	1,350	2,460
Rhutson Case	Grain	1,010	1,250	1,590	1,350	1,340	1,450
Flemington, Hunterdon co	Straw	1,080	1,320	1,800	1,510	1,530	1,700
David F. Pursel	Grain	1,680	1,910	1,480	1,280	1,530	1,690
New Village, Warren co	Straw	2,590	3,260	2,020	1,420	1,750	2,020

TABLE III.

Nitrogen and potash were, in each case, added to the mixtures already discussed under table II. Four complete fertilizers were thereby formed, which differ from each other only in the *quality* of their phosphoric acid.

Under these conditions, when used on corn, the floats, the precipitated phosphate of lime and the bone-black superphosphate were almost identical in their results, indicating that either potash or nitrogen may have been the true cause of the very marked increase which followed the use of these fertilizers.

On the rye crop, also, other conditions seem to have exercised greater influence than the phosphates; the soluble phosphoric acid, however, excels, and the grain from the other three phosphates is practically identical in weight.

Mr. Irons' report indicates that all four complete fertilizers were, in effect, of equal value on his wheat, and largely increased the crop, but in the other wheat experiments, those fertilizers with soluble and precipitated phosphates give larger crops than those made from the phosphoral and floats. In two cases the soluble phosphoric acid excels the precipitated phosphate of lime, but in two cases the precipitated phosphate gives the highest yields.

Floats and phosphoral are also practically identical in their effects upon wheat, the slight differences being in favor of phosphoral.

CONCLUSIONS.

It was hoped that the results from this series of experiments would be definite; it is now evident, however, that they can be regarded as indications merely, not as positive proof.

They give to the precipitated phosphate of lime, soluble in citrate solution at 100° Fah., a higher rank than it occupies in the minds of many chemists, making it practically equal, in agricultural value, to those phosphates which readily dissolve in water.

The results also create an impression that the phosphoric acid, in phosphoral, which dissolves in citrate solutions at temperatures ranging from 100° to 150° Fahr., is more valuable, agriculturally, than that in floats which does not yield to this treatment. They do not,

TABLE III.

	Number of Plot.	10	11	12	13	14
	Fertilizers Used per Acre.	Precipitated Plaster, 180 lbs. Floats, 250 lbs. Muriate of Potash, 100 lbs. Sulphate of Ammonia, 145 lbs.	Precipitated Plaster, 180 lbs. Phosphoral, 185 lbs. Muriate of Potash, 100 lbs. Sulphate of Ammonia, 145 lbs.	Precipitated Plaster, 180 lbs. Precipitated Phosphate of Lime, 255 lbs. Muriate of Potash, 100 lbs. Sulphate of Ammonia, 145 lbs.	Bone-Black Superphosphate, 310 lbs. Muriate of Potash, 100 lbs. Sulphate of Ammonia, 145 lbs.	No Fertilizer.
	Kind and Quantity of Plant-food per Acre.	Sulphate of Lime, 164 lbs. Phosphoric Acid Insoluble, 60 lbs. Potash, 50 lbs. Nitrogen, 30 lbs.	Sulphate of Lime, 164 lbs. Phos. Acid Available at 150°, 60 lbs. Phos. Acid Insoluble, 31.4 lbs. Potash. 50 lbs. Nitrogen, 30 lbs.	Sulphate of Lime, 164 lbs. Phos. Acid Available at 100°, 60 lbs. Phos. Acid Insoluble, 9.4 lbs Potash, 50 lbs. Nitrogen, 30 lbs	Sulphate of Lime, 163 lbs Phos Acid Soluble, 60 lbs Potash, 50 lbs Nitrogen, lbs.	
CORN.		lbs.	lbs.	lbs.	lbs.	lbs.
Arnold & Stephens Independence, Warren co.	Ears of Corn Good.	5,640	5,430	5,770	5,780	3,300
	Ears of Corn Poor...	830	650	580	560	1,340
	Stalks	6,150	6,430	7,500	7,260	5,280
RYE.						
Theodore West College Farm, Middlesex co.	Grain	2,950	2,950	2,890	3,180	3,200
	Straw	5,750	5,950	5,960	5,470	5,250
WHEAT.						
J. H. Irons Manchester, Ocean co.	Grain	488	490	500	505	145
	Straw	755	745	695	873	285
J. E. Parmly Oceanic, Monmouth co.	Grain	660	630	1,060	940	380
	Straw	1,080	1,260	1,500	1,290	570
Ezra Dayton Basking Ridge, Somerset co.	Grain	1,130	1,010	1,440	1,280	790
	Straw	1,800	1,640	2,550	2,220	1,310
Rhutson Case Flemington, Hunterdon co.	Grain	1,350	1,440	1,910	1,930	980
	Straw	1,450	1,700	2,350	2,520	1,050
David F. Pursel New Village, Warren co.	Grain	1,750	1,840	2,240	2,320	1,540
	Straw	2,060	2,220	2,930	2,780	1,860

however, allow this phosphoric acid to rank with that from superphosphates and precipitated phosphates of lime.

Other experiments on grain are now in progress, to study this question still further. If they are finished without accidents, they will be reported in due season.

FIELD EXPERIMENTS WITH FERTILIZERS ON PEACH TREES.

BY STEPHEN C. DAYTON, BASKING RIDGE, SOMERSET COUNTY, N. J.

Number of Plot.	FERTILIZERS.			Average Height of Trees per Plot in Feet.	Number of Peaches per Plot.	Weight of Peaches per Plot in Pounds.	Weight of 3 Largest Peaches in Each Plot in Pounds.
	Kind.	Weight per Acre.	Cost per Acre.				
1	Nothing	....	....	8.65	4	....	....
2	Nitrate of Soda	150 lbs.	$4 05	8.71	10	2.3	0.8
3	Superphosphate	350 lbs.	3 67	9.81	25	7.0	1.2
4	Muriate of Potash	150 lbs.	3 00	8.81	3	1.0	1.0
5	Nitrate of Soda Superphosphate	150 350 500 lbs.	7 72	9.96	46	13.0	1.4
6	Nothing	....	....	9.00	12	3.0	1.0
7	Nitrate of Soda Muriate of Potash	150 150 300 lbs.	7 05	9.25	3	1.0	1.0
8	Superphosphate Muriate of Potash	350 150 500 lbs.	6 67	9.86	14	3.3	1.0
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 150 650 lbs.	10 72	10.10	16	4.1	1.0
10	Plaster	400 lbs.	1 50	9.56	12	3.3	1.0
11	Fine Barn-yard Manure	20 2 horse loads.	30 00	10.50	11	3.0	1.0
12	Barn-yard Manure Lime	10 loads 50 bushels	....	9.56	....	....	....

This experiment was begun in 1884. Corn was planted in that year and followed in 1885 by buckwheat. No field crop was grown on these plots in 1886. The ruling fertilizing element upon this farm for grain and grass has been phosphoric acid. Peach trees were planted April 24th, 1884, accurate measurements of the trees were made in November, 1886, and are published this year largely as a matter of record.

The cultivation and treatment of the orchard during the past season is clearly stated in the report of Mr. Dayton:

"The plots were plowed in April, as early as the ground was in good condition, the fertilizers sown and harrowed in, and the harrowing repeated to keep down the weeds and stimulate the growth of the trees. The trees were trimmed early in June, the ground plowed again early in July and harrowed, after which the weeds were cut.

"The main branches of the trees have made a growth this year of from three feet to four feet three inches in length, and with few exceptions are in a healthy and thrifty condition. Three trees in plot 4 and one in plot 3 were girdled by the mice and have been replaced by young trees.

"The trees on plot 6 show that this ground, producing without fertilizers only ten bushels of buckwheat in a fair season, will, with good care, grow peach trees to the age of fruit-bearing, in as healthy and thrifty a condition as could be desired; and it is also noticeable that while superphosphate has increased the growth of straw and stalks three or four-fold, it has increased the growth of the trees but little in three years."

FIELD EXPERIMENTS WITH FERTILIZERS ON RED CLOVER.

BY J. M. DALRYMPLE, HOPEWELL, MERCER CO., N. J.

Number of Plot.	FERTILIZERS.			Pounds per Acre.	Gain or Loss per Acre in Pounds.	Net Profit or Loss per Acre.
	Kind.	Weight per Acre.	Cost per Acre.			
1	Nothing	....	....	2,850	....	....
2	Nitrate of Soda	150 lbs.	$4 05	3,750	+700	—$0 55
3	Superphosphate	350 lbs.	3 67	2,900	+50	—3 42
4	Muriate of Potash	150 lbs.	3 00	4,650	+1,600	+5 00
5	Nitrate of Soda .... Superphosphate	150 350 500 lbs.	7 72	5,350	+2,300	+3 78
6	Nothing	....	....	3,250	....	....
7	Nitrate of Soda .... Muriate of Potash	150 150 300 lbs.	7 00	5,350	+2,300	+4 50
8	Superphosphate .... Muriate of Potash	350 150 500 lbs.	6 67	5,350	+2,300	+4 83
9	Nitrate of Soda .... Superphosphate .. .. Muriate of Potash	150 350 150 650 lbs.	10 72	6,250	+3,200	+5 28
10	Plaster	400 lbs.	1 50	2,900	—150	—2 25
11	Fine Barn yard Manure ..	20 2-horse loads.	30 00	5,050	+2,000	—20 00

This is the third experiment in the rotation. The season throughout was favorable for growing clover.

All fertilizing materials except plaster exerted a favorable effect.

Nitrogen and potash are the ruling elements.

Superphosphate seems to have exerted but little influence when used alone, but when used in combination with nitrogen or phosphoric acid, or as a complete manure, its effect is quite as marked as that of nitrogen or potash. The barn-yard manure increased the yield by one ton per acre; this increase is largely exceeded by that from the complete manure, and by the combinations used upon plots 5, 7 and 8.

Muriate of potash alone produced a net profit of $5 per acre; this profit is only increased by twenty-eight cents on the addition of nitrogen and phosphoric acid in the complete manure. The apparent loss of $20 per acre from the use of barn-yard manure would seem to indicate that profit from increased yields must come through the use of chemical fertilizers.

FIELD EXPERIMENTS WITH FERTILIZERS ON RYE.

BY N. S. SERGENT, SCHOOLEY'S MOUNTAIN, HUNTERDON COUNTY, N. J.

Number of Plot.	FERTILIZERS.			YIELD PER ACRE.			Net Gain or Loss Per Acre.
	Kind.	Weight per Acre.	Cost per Acre.	Pounds of Grain.	Bushels of Grain.	Pounds of Straw.	
1	Nothing	....	....	1,120	20.0	1,500	....
2	Nitrate of Soda	150 lbs.	$4 05	1,100	19.6	1,560	—$3 90
3	Superphosphate	350 lbs.	3 67	1,720	30.7	2,660	+10 29
4	Muriate of Potash	150 lbs.	3 00	1,010	18.0	1,680	—3 00
5	Nitrate of Soda Superphosphate	150 350 } 500 lbs.	7 72	2,200	39.30	3,630	+17 71
6	Nothing	....	....	1,160	20.7	1,590	....
7	Nitrate of Soda Muriate of Potash	150 150 } 300 lbs.	7 00	1,080	19.3	1,560	—7 00
8	Superphosphate Muriate of Potash	350 150 } 500 lbs.	6 67	1,880	33.6	2,980	+11 11
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 150 } 650 lbs.	10 72	2,070	37.0	3,740	+14 04
10	Plaster	400 lbs.	1 50	1,320	23.6	2,090	+4 50
11	Fine Barn-yard Manure	20 2-horse loads	30 00	2,050	36.6	3,350	—8 00

This experiment is the third in the series upon this farm.

The yields from the unmanured plots for the three years indicate a high state of fertility.

EFFECT OF FERTILIZERS.

Nitrate of soda and muriate of potash were of no effect, either when used alone or in combination with each other.

Superphosphate largely increased the yield of both grain and straw. The highest yield of grain was secured when used in combination with nitrate of soda upon plot 5, and the largest yield of straw from the complete manure on plot 9.

Plaster increased the yield of grain 3.6 bushels and of straw 590 pounds.

The increased yield from the use of barn-yard manure upon plot 11 was excelled by that from both 5 and 9, and almost equaled by that from 8, upon which phosphoric acid and potash were used in combination.

PROFIT AND LOSS.

A loss was entailed by the use of nitrate of soda and muriate of potash, both alone and in combination with each other.

The large increase in yield produced by barn-yard manure was secured at an apparent loss of $8 per acre.

Superphosphate was profitable wherever used; the greatest profit, $17.71 per acre, was secured from nitrogen and phosphoric acid on plot 5.

Plaster was also profitable.

FIELD EXPERIMENTS WITH FERTILIZERS ON MIXED [Grasses] HAY.

BY S. P. RIDGEWAY, HURFFVILLE, GLOUCESTER CO., N. J.

Number of Plot.	FERTILIZERS.		Cost per Acre.	Pounds per Acre.
	Kind.	Weight per Acre.		
1	Nothing	....	....	750
2	Nitrate of Soda	150 lbs.	$4 05	1,550
3	Superphosphate	350 lbs.	3 67	750
4	Muriate of Potash	150 lbs.	3 00	3,750
5	Nitrate of Soda Superphosphate	150 350 } 500 lbs.	7 72	2,500
6	Nothing	....	....	1,950
7	Nitrate of Soda Muriate of Potash	150 150 } 300 lbs.	7 00	4,450
8	Superphosphate Muriate of Potash	350 150 } 500 lbs.	6 67	4,750
9	Nitrate of Soda Superphosphate Muriate of Potash	150 350 150 } 650 lbs.	10 72	5,950
10	Plaster	400 lbs.	1 50	1,750
11	Fine Barn-yard Manure	20 2-horse loads.	30 00	5,250

This is the third experiment in the rotation on this farm.

The soil is loamy, with clay and gravel subsoil, and is well adapted to corn, potatoes, wheat and clover.

Previous experiments have shown that all the fertilizing elements produce an increase in yield, though, owing to unfavorable seasons, a financial profit was not secured in any case.

In the fall of 1885 very little clover or timothy could be observed upon any of these plots. In order to continue the experiment through the rotation, clover seed was again sown and lightly harrowed.

Observations taken May 24th, 1886, showed a fair stand upon plots 4, 7, 8, 9 and 11; the remaining plots ranged from very poor upon plot 1 to fair upon plot 10. The crop was harvested June 28th, and weighed in good condition June 30th; the weights then recorded correspond very closely with the observations taken in May.

It is evident that this result was largely due to the favorable effect produced by the muriate of potash in securing a stand, since, with the exception of plot 11, the crop was very light where no muriate of potash was used.

The unmanured land, in this experiment, does not seem to be strictly uniform in fertility; in 1884 the largest yield was secured from No. 6; in 1885 No. 1 was slightly ahead, and for this crop No. 6 is again superior.

In the computations which follow the product from No. 6 is taken as representing the fertility of the unmanured land.

Regarding $10 per ton as the price for mixed hay, No. 4 yielded a net profit of $6 per acre; No. 7, a profit of $5.50; No. 8, $7.33, and No. 9, $9.28.

SORGHUM.

THE EXTRACTION OF SUGAR FROM SORGHUM, AT RIO GRANDE, CAPE MAY COUNTY, NEW JERSEY.

FIELD EXPERIMENTS UPON THE GROWTH OF SORGHUM.

The southern counties in this State include thousands of acres which are believed to be suitable for sugar plantations, especially in regard to climate and soil. At present this land is either unproductive or is farmed in a manner which affords scanty returns only to labor and capital.

Numerous experiments have shown that, when fertilizers are judiciously used, this soil yields large crops of rich cane, and six years' work, on a manufacturing scale, has developed methods and machinery by which nearly all of the sugar in this cane can be secured in merchantable forms. The opinion is therefore entertained that the sorghum sugar industry can be profitably established in this section of the State as soon as the following points have been properly demonstrated :

1. The most economical manner in which to equip and arrange a sugar-house.

2. A working season of at least one hundred days. This will probably be attained, partly by a suitable selection of varieties of sorghum, partly by regulating the ripening of the crop by means of fertilizers, and partly by the development of method for preserving or storing cane.

3. The utilization of waste products. A sugar-house which produces from forty to fifty thousand dollars' worth of sugar and syrup annually should also produce at least fifteen thousand dollars' worth of paper pulp from the bagasse and six thousand dollars' worth of

seed. The leaves should also be utilized and made to pay the expenses incurred in stripping them from the cane.

Most of these points have been noticed in the report of the past season's work, printed in detail upon the following pages.

THE EXTRACTION OF SUGAR FROM SORGHUM, AT RIO GRANDE, CAPE MAY COUNTY, NEW JERSEY.

In 1883, Messrs. Geo. C. Potts & Co., lessees of the Rio Grande Plantation, attempted to secure an increased yield of juice from sorghum by the use of a supplementary mill. After one season's work this attempt was abandoned, and a diffusion battery was substituted in which to work bagasse. The sugar was then thoroughly extracted, but in such an impure condition that, after a comparatively short trial, this process was also abandoned.

In 1885, diffusion was again tested. As the result of twenty-six days' work, two hundred and twenty-nine barrels of molasses were made from a portion only of the mill bagasse. This molasses was graded low, both in color and taste; it was sold, however, for considerably more than it cost, and demonstrated to the satisfaction of practical men that a first-class cane mill can be an extremely wasteful machine.

Meanwhile Superintendent Hughes and the chemist of this Station were experimenting at Rio Grande, upon a small scale, their aim being:

1. To compare mill juice from unstripped cane with diffusion juice from thoroughly clean stalks.

2. To compare the diffusion juices from stripped and unstripped sorghum.

The results were as follows:

1. Eighty-nine per cent. of the total sugar in the cane was secured by diffusion. Forty-eight per cent. of the total sugar in the cane was secured by milling. Mill products, therefore, must be increased by eighty-four per cent. in order to equal diffusion products.

2. Diffusion juices from stripped cane excel mill juices from unstripped cane in concentration, color, taste and purity. Diffusion juices from unstripped cane are inferior to mill juice in all of these respects.

As a result of these experiments, it was claimed that leaves, leaf sheaths and seed were the chief obstacles to the introduction of diffusion. This claim was admitted by Mr. Potts, and Mr. Hughes was directed to construct his stripping machine.

It is believed that no machine adapted to this work was then in existence. In addition to the difficulties which were, of course, expected, serious delays were caused by labor troubles among metal workers in Philadelphia. In consequence, when the sugar season opened the house was in confusion. Work was pushed forward, however, and substitutes found for all imperfect appliances. The season resulted in a financial loss; this loss is, however, in a measure, balanced by the information which has been gained.

A brief summary of the season's results is as follows:

1. The cane this season contained from one hundred and fourteen to one hundred and twenty pounds of sugar per ton. This crop is, therefore, the poorest to be found upon the records of this plantation.

2. Three hundred and ninety-four tons were milled in the usual manner. Forty-one per cent. of the total sugar was secured in merchantable forms, and fifty-nine per cent. was wasted in the scum and mill bagasse.

3. Seven hundred and twenty-eight tons were stripped of leaves and seed tops by machinery and then diffused. Seventy per cent. of the total sugar was secured in merchantable forms, and thirty per cent. was wasted in the bagasse. The absolute yields, on the basis of stripped and topped cane, were eighty-five pounds of raw sugar and ten gallons of molasses per ton.

4. With the above extraction, mill products must be increased by seventy-one per cent. in order to equal diffusion products. In quality the products were identical.

5. Four hundred and twenty tons of cane were prepared for diffusion at a time when leaves and seed tops were wet with dew and rain. The leaves were imperfectly removed and the diffusion products were in all respects inferior in quality and quantity.

6. Experience has shown—

    1. That if a slight change is made in one of the machines, ninety per cent. of the total sugar can be extracted in merchantable forms.

    2. That the stripping machines can be modified and enlarged so as to insure good work under any condition liable to exist.

7. Experience indicates—

   1. The need of utilizing diffusion bagasse in the preparation of paper pulp.
   2. The need of developing methods for storing cane for use during the winter.
   3. The probability that financial success can be attained if a sugar-house is properly equipped for working sorghum.

The detailed descriptions and results have been arranged in the following order:

I.

A DESCRIPTION OF THE METHODS ADOPTED AT RIO GRANDE FOR EXTRACTING SUGAR FROM SORGHUM.

II.

A DETAILED REPORT OF THE PAST SEASON'S WORK.

III.

THE CHANGES AND IMPROVEMENTS NEEDED IN ORDER TO INCREASE RECEIPTS AND DIMINISH EXPENSES.

IV.

FINANCIAL CONSIDERATIONS.

The report of this Station for 1884 contains a history of the Rio Grande Sugar Plantation, but in this history brief mention only is made of the details of the method by which sugar is extracted from cane juices and converted into merchantable forms. A full account of this process is now necessary in order to simplify the report of the past season's work.

I.

A DESCRIPTION OF THE METHODS ADOPTED AT RIO GRANDE FOR EXTRACTING SUGAR FROM SORGHUM.

1. *Separation of cane juice from cane fiber.*
2. *Clarification of cane juice.*
3. *Evaporation.*
4. *Separation of sugar from molasses.*

1.

SEPARATION OF CANE JUICE FROM CANE FIBER.

For separating cane juice from cane fiber two methods only are now in use, viz., milling and diffusion. This house is equipped for work by either method, the change from one to the other requiring less than six hours' time.

When the mill is in service the work is very simple. The cane, with leaves and seed tops still attached, is lifted by steam power from the cars in bundles weighing three hundred pounds each; these bundles are then swung under a guillotine and ninety per cent. of the seed tops instantly removed by a single blow. The topped but still unstripped cane is spread upon a carrier in a bed eight inches deep; this bed is then drawn between the mill rollers at the rate of from 160 to 190 tons per day of twenty-two hours.

As the juice flows from the crushed stalks it is collected in a storage tank until it amounts to one thousand gallons; its subsequent manipulation will be described later. The crushed stalks, known as mill bagasse, are converted into compost.

When the diffusers are in use the separation of cane juice from cane fiber is somewhat complicated. The bundles of sorghum, each weighing three hundred pounds, are raised by steam power to a platform, upon which they are opened. From this platform the cane is arranged in a bed five feet wide, and conveyed by a carrier, butt ends foremost, to a heavy revolving knife. The speed of the carrier is so regulated that at each revolution this knife cuts off four inches of the cane bed until the seed tops are reached. By a very ingenious arrangement these seed tops escape the knife by dropping through a trap door, which is turned by hand at the proper moment. This separation of seed tops from the unstripped cane has been found to be thoroughly satisfactory.

The four-inch sections of cane mixed with leaves, but practically free from seed, are elevated to a fan which blows away much of the leaf, and wastes under favorable conditions very little or none of the stalk. Two small knives, each revolving nearly two thousand times per minute, next shave these cleaned sections into chips and the cane is then ready for diffusion.

Diffusers are simple air-tight vessels or cells made of boiler iron, with a convenient arrangement of pipes for water, steam and juice. The report of this Station for 1885 contains the following description:

"At Rio Grande there are ten diffusers, each of which has a capacity of seventy-two cubic feet, and consequently can hold forty-five hundred pounds of water.

" When in operation each of these cells should be packed with finely-cut sorghum and closed air-tight; water should then be forced in through the bottom of the first cell until it flows from the air-cock at the top. In passing through this cell the water takes up a very large portion of the total sugar stored in the cane, but the solution is too dilute to admit of economical working; it is, therefore, slowly forced in succession through the cane in the remaining nine cells, and when finally discharged it should be nearly as concentrated as mill juice.

" Water fills the first cell whenever dilute juice is forced into the second, third or following cells, consequently when the juice flows from the last diffuser, the cane sections in the first will have been extracted ten times with pure water and should then contain traces only of sugar. This extracted cane is called diffusion bagasse and is removed to the compost field. Cell No. 1 is then refilled with fresh sorghum and becomes No. 10 in battery. When the contents of cell No. 2 have been leached ten times with water and dilute juice, this cell is also cleaned and refilled with fresh sorghum. As each following cell in turn is treated in a similar manner the process is made continuous."

2.

CLARIFICATION.

Normal cane juice secured either by milling or by diffusion is acid in reaction, and in addition to sugar contains a number of compounds, some of which are simply suspended in the water, while others are in solution. The amount of suspended matter is variable, depending largely upon the carefulness of a single workman.

The process of neutralizing the acid and removing from the sugar solution all of the suspended and some of the dissolved matter, is termed clarification.

Four copper caldrons, called clarifiers, each holding five hundred and fifty gallons, are used for this work. Each clarifier is enclosed in a steam-jacket properly provided with safety-valves, drip-cocks and all other attachments necessary for rapidly handling cane juice and heating it to its boiling point. For convenience in removing scum, &c., the clarifiers are supported upon a platform six feet above the ground. A force pump is used in filling them with mill juice, but the water pressure, with which the battery is operated, is strong enough to raise the diffusion juice to the necessary level.

About five hundred gallons of juice are taken for each clarification. It is first treated, to nearly neutral reaction, with freshly slacked lime, mixed in water to a fine whitewash; then steam is turned into the jacket and the temperature allowed to rise to 190° Fahr., at which point a sufficient amount of yellow lime* is added. By this time the surface will be covered by a grayish-white scum, more or less heavy, according to the quality of the juice. As soon as this scum breaks, showing a pure white foam, the steam is shut off, as the temperature then will be not far from 210° Fahr. Within half an hour the heavier precipitate which also forms will have subsided, and the clear juice may be drawn off. After the scum and precipitate have been washed into a settling tank, the clarifier will be ready for another charge.

3.

EVAPORATION.

For each pound of sugar present in cane juice there is, roughly, ten pounds of water, nearly all of which must be boiled away before the sugar can be secured in merchantable forms. The apparatus for this work is arranged in the third story of the building and consists of four open evaporators, one double-effect vacuum and two ordinary vacuum pans. The double-effect was not used during the past season because of a scarcity of water for condensation purposes.

Vacuum pans are strongly-constructed air-tight vessels of iron or copper, connected with powerful air pumps and fitted with steam coils, condensers, thermometers, proof-sticks, &c. The principle upon which they depend is extremely simple—for instance, water, which boils or changes into steam at 212° Fahr. when heated in open vessels, changes into steam at 70° Fahr., and lower, if heated in a perfectly tight flask absolutely free from air and all other gases. Syrup, which boils at 220° Fahr. in an open evaporator, boils at 120° Fahr. in a good vacuum pan, and all risks of burning or inverting its sugar are thereby avoided.

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*Made by saturating cream of lime with sulphur fumes. (Sulphurous acid gas.)

The cane juice, warm from the clarifiers, is pumped into the open evaporators; here five hundred gallons of juice are quickly concentrated to two hundred and fifty gallons. This product is then drawn into a small vacuum pan and boiled down to, approximately, one hundred gallons. Successive charges from the evaporators are similarly treated, until this vacuum pan contains perhaps eight hundred gallons of a concentrated product indicating 55°–60° Brix, equivalent to 30°–33° Baume. This is known as "feed for pan;" it is allowed to flow from the vacuum into a tank upon the second floor.

SEPARATION OF SUGAR FROM MOLASSES.

The "feed for pan," although it is very concentrated, still contains enough water to hold in solution all of the sugar secured from the cane, as well as many impurities which resist clarification. This water must, therefore, be evaporated, but in such a manner that the sugar may be secured in uniform crystals of a proper size, and thus be separated from the impurities which remain in the semi-fluid product called molasses.

Briefly, this is done in the following manner: Several hundred gallons of the "feed for pan" are drawn into the large vacuum pan, and there concentrated until the sugar separates in minute crystals known as "sparks." These are visible only when samples are drawn from the pan by means of the proof-stick, and allowed to flow over a small plate of glass. The sugar boiler then aims to increase the size of the "sparks" until they become "grains." He does this by drawing small quantities of the pan feed, every few minutes, into his pan, at the same time carefully regulating the vacuum and heat. If too much feed is drawn in, it dissolves the crystals, and a part of the work must be repeated; if, on the other hand, the evaporation is too rapid, new sparks and small grains will form, giving crystals of various sizes in the same pan, and preventing or seriously hindering a subsequent step of the process. Experienced and careful men, however, easily avoid both dangers, and in a very few hours concentrate in a single pan all that is valuable to the sugar industry in a hundred tons of cane.

The contents of the pan, now called melada, are allowed to run out into small iron tanks placed on wheels, and known as sugar wagons, each of which holds, approximately, 2,600 ℔s. These are rolled into a room in the second story of the building, in which the temperature varies only between 110° and 120° Fahr. The melada remains under these conditions from eight to ten days, during which time the sugar crystals increase somewhat in size. At the close of this period, the wagons are emptied into the mixer, whence the melada is drawn into the centrifugal machines located upon the first floor of the house.

If the sugar boiler has had juice of good quality and has managed his pan so that uniform crystals of a proper size only have formed, then the separation of these crystals from the molasses is easily effected, and the sugars "run dry" in a very short time. If false grain has formed in the pan, or if the juice was "gummy," then the machines may run almost indefinitely without removing the molasses. This molasses flows from the centrifugals into underground tanks, but the sugar must be removed from the machines by hand, then ground in a mill and immediately packed into hogsheads holding 2,000 ℔s. each. The tanks are emptied daily, the molasses being first diluted to 38° Baume, and then drawn into barrels ready for shipment.

Lime kilns, carbonic acid pumps, filter presses and bone-black filters, with the expensive arrangements for purifying and keeping the bone-black in proper order, are not included in the equipment of this house. Those who are familiar with the sugar beet industry may, therefore, conclude that proper results can hardly be expected from such a plant. In reality, however, with very few changes, this plant can secure in merchantable forms ninety per cent. of the total sugar present in sorghum.

II.

THE RESULTS OF THE PAST SEASON'S WORK AT RIO GRANDE.

1. *Milling and diffusion under ordinary conditions.*
2. *Comparison of the results.*
3. *Diffusion under unfavorable conditions.*

1.

MILLING UNDER ORDINARY CONDITIONS.

The concentration and purity of mill juice both before and after clarification and evaporation.

The yields of sugar and molasses from mill juice.

The losses of sugar in the scum and mill bagasse.

On the 4th, 5th and 6th of October, a crop of Kansas orange sorghum was harvested from one-half of a large field; the crop upon the other half was reserved for a future experiment. The yield was *three hundred and ninety-four tons two hundred and ninety-six pounds* of unstripped and untopped cane, from which the mill extracted twenty-nine thousand five hundred and eighty gallons of juice, or *seventy-five gallons per ton.* Eight tons only were ground upon the 4th inst., but one hundred and ninety-three tons daily were worked upon the 5th and 6th inst.

THE CONCENTRATION AND PURITY OF MILL JUICE BOTH BEFORE AND AFTER CLARIFICATION AND EVAPORATION.

The juice from the above cane was collected in a storage tank, whence it was pumped from time to time into the clarifiers, each of which was filled to a mark indicating 510 gallons. Its treatment at this stage has been already described.

Each clarifier was sampled both before and after clarification; the average analyses of the samples in each case were as follows:

	Sugar.	Brix at 14°.	Purity.
Before clarification...............	8.93 per cent.	12.99	68.75
After "	9.12 "	13.17	69.19

This comparison indicates that the purity of the crude mill juice was not materially improved by the clarification. The very frothy scum removed nearly all of the suspended matter, but it contained, relatively, only a very small amount of the soluble impurities.

After the clarified juice had been concentrated in the open evaporators and small vacuum, the resulting "feed for pan" averaged:

Sugar.	Brix at 14°.	Purity.
40 per cent.	59.33	67.42

The following proportion indicates what the pan feed, under the above conditions, should have tested:

Brix of purified juice.		Brix of feed for pan.		Per cent. of sugar in juice.		Calculated per cent. of sugar in pan feed.
13.17	:	59.33	: :	9.12	:	41.08

Instead of 41.08 per cent., the analysis indicated only 40 per cent., making it appear that a small quantity of sugar had been inverted in the open evaporators.

THE YIELDS OF SUGAR AND MOLASSES FROM MILL JUICE.

The melada from this "feed for pan" filled sixteen sugar wagons, and was at once recognized as superior in quality. Eight days later it was passed through the centrifugal machines and yielded fourteen thousand four hundred pounds of 83 test sugar and seventeen hundred gallons of 39° Baume molasses, or thirty-six and two-thirds pounds of 83 test sugar and four and one-third gallons of molasses per ton of unstripped and untopped cane.

The four and one-third gallons of molassess weighed, approximately, forty-nine and one-half pounds, and tested by Clerget's method 32.7 per cent.; consequently, the mill molasses from each ton of unstripped and untopped cane contained sixteen and one-quarter pounds of 100 test sugar.

The crystallized product obtained, viz., thirty-six and six-tenths pounds per ton, was 83° test, hence it represented only thirty and four-tenths pounds of 100 test sugar.

4.33 gallons molasses contain.....	16.25	pounds	100	test	sugar.
36.6 pounds of 83 test represent..	30.40	"	"	"	"
Total	46.65	"	"	"	"

One ton of unstripped and untopped cane yielded forty-six and seven-tenths pounds of 100 test sugar, of which 65 per cent. crystallized and 35 per cent. remained in the molasses.

LOSSES OF SUGAR IN THE SCUM AND MILL BAGASSE.

The following calculations indicate that, on the average, each ton of the unstripped and untopped cane used in this milling trial contained one hundred and fourteen pounds of 100 test sugar, viz., 2,000 pounds of unstripped and untopped sorghum include 500 pounds of leaf and seed and 1,500 pounds of clean cane; of this clean cane, 85 per cent., or 1,275 pounds, is juice, uniform in composition with that extracted by the mill. This juice has been shown to contain 8.93 per cent. of sugar; hence, one ton of unstripped and untopped cane contained one hundred and fourteen pounds of 100 test sugar (1,275 pounds × 8.93 per cent.)

The mill products, viz., merchantable sugar and molasses, have been shown to represent forty-six and seven-tenths pounds of 100 test sugar; hence, there must have been wasted in mill bagasse and scum (114 — 46.7) sixty-seven and three-tenths pounds of 100 test sugar, or 59 per cent. of the total amount produced in the field.

1.

DIFFUSION UNDER ORDINARY CONDITIONS.

Stripping and topping cane.
Manipulation of the diffusion battery.
Concentration and purity of diffusion juices both before and after clarification and evaporation.
Yields of sugar and molasses by diffusion.
Losses of sugar in the waste products from the battery.

The crop upon the second half of the field of Kansas orange sorghum and a portion of the crop from an adjoining field in Early Orange cane were harvested during the period October 9th to October 23d. The yield was seven hundred and twenty-seven tons eighteen hundred and eighty-nine pounds of unstripped and untopped cane.

This was stripped and topped as described in the previous chapter and then diffused.

STRIPPING AND TOPPING CANE.

On the twentieth of October a test was made to determine the losses in weight suffered by cane during the process of stripping and topping. Thirty-six tons were found to lose nine thousand two hundred pounds, or 12.8 per cent., by the removal of seed tops, and five thousand nine hundred and thirty-five pounds, or 8.24 per cent., by removal of leaves and sheaths. The cane, therefore, when it reached the diffusers, was reduced in weight by twenty-one per cent.

MANIPULATION OF THE DIFFUSION BATTERY.

The records show that four hundred and fifty-five tons of unstripped and untopped cane were worked during a given period, and that four hundred and fifty-six diffusers were filled; with the above deduction of twenty-one per cent. for leaves, sheaths and seed tops, each diffuser therefore averaged *fifteen hundred and seventy-six* pounds of cleaned cane. This cane was by no means entirely free from leaves. The amount present, however, appears to have been too small to affect in any way the color and taste of the diffusion products.

The diffusers were worked at about 60° R., and each discharge approximated two hundred gallons of juice.

CONCENTRATION AND PURITY OF DIFFUSION JUICES BOTH BEFORE AND AFTER CLARIFICATION AND EVAPORATION.

Samples of the diffusion juice were drawn from each clarifier both before and after clarification. The average results, in each case of eleven analyses, are as follows:

	Sugar.	Brix at 14° R.	Purity.
Before clarification............	7.59 per cent.	11.56	65.57
After "	7.63 "	11.62	65.66

Clarification seems to have been almost entirely without effect upon diffusion juices, for the scum and sediment combined, from a tank of five hundred and ten gallons, amounted to less than a pailful of light frothy material. The chips of cane and the iron gratings in the diffusers evidently act as a filter, by which suspended impurities are removed. This clarified diffusion juice was boiled down in the open evaporators and small vacuum pan and the resulting feed for pan was sampled and analyzed daily.

The average of eight analyses was found to be:

Sugar.	Brix at 14° R.	Purity.
38.30 per cent.	55.40	69.10

A calculation similar to that made in the case of mill juice brings out an interesting, but probably well-known fact, viz., that under certain conditions, juices increase in purity during evaporation, owing probably to the precipitation of salts of organic acids.

Brix of purified juice.		Brix of feed for pan.		Per cent. of sugar in juice.		Per cent. of sugar in feed for pan.
11.62	:	55.40	: :	7.63	:	36.39

The calculated per cent. of sugar is found to be 36.39; the actual analysis indicates, however, 38.30 per cent., hence it follows that the Brix 55.40 is not as high as the evaporation requires on the supposition that no loss of solid matter occurred during the process; another proportion indicates, however, that in all probability such a loss actually took place.

Per cent. of sugar in diffusion juice.		Per cent of sugar in feed for pan.		Brix in diffusion juice.		Calculated Brix in feed for pan.
7.63	:	38.30	: :	11.62	:	58.3

Had no such change or loss occurred, instead of the actual Brix 55.40 the reading would have been 58.3.

WORKING WITHOUT THE USE OF CLARIFIERS.

The absence of all noticeable results from the attempts to clarify diffusion juice led to a trial of the effect of working without clarification.

The yellow lime was added in small quantities to the chips as they fell into the diffusers, in order to prevent any possible souring or inversion in the battery; the use of slacked lime was for the time abandoned.

The juice was forced into the clarifiers and sampled as usual. It was then raised to the boiling point and again sampled. The feed for pan secured by boiling down this juice was also carefully examined.

The results are as follows:

	Per cent. of sugar.	Brix at 14°.	Purity.
Diffusion juice before heating..........	7.80	11.87	65.71
" " after "	7.85	11.87	66.14
"Feed for pan" from above juice......	39.20	56.97	68.82

As far as can be seen, the above data fail to indicate any advantage whatever in the use of freshly slacked lime.

The use of white and yellow lime in the clarifiers was, therefore, abandoned for a time without any unfavorable consequences.

The unwillingness to accept the responsibility of so radical a step without ample opportunities for closely studying the results caused, however, a return to the old process.

YIELDS OF SUGAR AND MOLASSES BY DIFFUSION.

The melada from the diffusion juice filled forty-five sugar wagons, and was, in all respects, a very satisfactory product.

After the usual time in the "hot room" this melada yielded 48,839 pounds of 83 test sugar and 5,656 gallons of 38 Baume molasses, equivalent to *sixty-seven and one-tenth* pounds of 83 test sugar, and *seven and eight-tenths* gallons of molasses for each ton of unstripped and untopped cane.

On the basis of stripped and topped cane, these yields are equivalent to *eighty-five* pounds of sugar and *ten* gallons of molasses per ton.

An analysis of a sample representing the total yield of molasses, viz., 5,656 gallons, proved that this molasses contained 26.6 per cent. of chemically pure sugar.

As seven and eight-tenths gallons weighed eighty-seven and eight-tenths pounds, it follows that the diffusion molasses from one ton of unstripped and untopped cane contained *twenty-four and two-tenths* pounds of 100 test sugar.

The sixty-seven and one-tenth pounds of 83 test sugar represents fifty-five and seven-tenths pounds of 100 test sugar.

Therefore, each ton of unstripped and untopped sorghum yielded to diffusion seventy-nine and nine-tenths pounds (24.2 + 55.7) of 100 test sugar, of which 69.7 per cent. crystallized and 30.3 per cent. remained in the molasses.

LOSSES OF SUGAR IN DIFFUSION WASTES.

Of the seven hundred and twenty-eight tons of sorghum used in the diffusion trial, three hundred tons came from the field from which the cane used in the milling experiment had been secured.

This, it will be remembered, averaged *one hundred and fourteen* pounds of 100 test sugar per ton.

The remaining four hundred and twenty-eight tons, harvested from a neighboring field, were of the Early Orange variety. Its quality was tested in the following manner:

Small portions of the stripped, topped and shredded cane were picked from the carrier during the time occupied in filling five diffusers; about fifty pounds were secured in this manner, from which a sub-sample was drawn; this was dried at 120° Fah., ground to a flour and extracted with boiling alcohol.

The alcoholic extract, properly purified and polarized, indicated that one ton of unstripped and untopped cane contained *one hundred and twenty pounds of 100 test sugar.*

For practical purposes, therefore, it is safe to assume that the entire lot of seven hundred and twenty-eight tons of cane used in the diffusion trial averaged not less than *one hundred and fourteen pounds* of 100 test sugar per ton.

Of this *one hundred and fourteen pounds* the diffusers secured *seventy-nine and nine-tenths pounds.* The diffusion bagasse and the waste-water from the battery must, therefore, have contained at least *thirty-four and one-tenth* pounds, or 30 per cent. of the total sugar produced in the field.

2.

A COMPARISON OF THE RESULTS SECURED BY MILLING AND BY DIFFUSION.

The relative concentration and purity of the juices.
The relative quantity and quality of the products.
Conclusion.

THE RELATIVE CONCENTRATION AND PURITY OF THE JUICES.

	Per cent. Sugar.	Brix at 14°.	Purity.
Mill juice before clarification	8.93	12.99	68.75
Diffusion juice before clarification	7.59	11.56	65.57

From the above data it is evident that one hundred pounds of sugar were dissolved in eleven hundred and twenty pounds of mill juice or in thirteen hundred and twenty pounds of diffusion juice.

Diffusion juice then contained an excess of fifteen per cent. of water, and, consequently, was the more expensive product to evaporate.

It is also evident that the mill juice was originally purer than the diffusion juice, but during the evaporation it deteriorated, while the diffusion product improved in quality. To illustrate:

	Per cent. Sugar.	Brix at 14°.	Purity.
Feed for pan from mill juice.............	40.00	59.33	67.42
" " " " diffusion juice	38.30	55.42	69.10

The effect of this difference in purity is seen in the sugar yield, for it has been shown that of the total amounts extracted in each case sixty-nine and seven-tenths per cent. crystallized from the diffusion melada, and under exactly similar conditions *sixty-five* per cent. crystallized from the mill melada.

THE RELATIVE QUANTITY AND QUALITY OF THE PRODUCTS.

The most important difference appears on comparing the absolute amounts of sugar won and wasted by both methods.

The mill, for instance, secured *forty-one per cent.* and wasted *fifty-nine* per cent. of the total sugar. The diffusers, on the other hand, secured *seventy per cent.* of the total sugar and wasted *thirty per cent.* In other words, out of one hundred and fourteen pounds of sugar, the mill secured *forty-six and seven-tenths pounds* and the diffusers secured *seventy-nine and nine-tenths pounds.*

In color and taste the mill and diffusion products were practically identical, and were sold without discrimination.

CONCLUSION.

If the mill secured *forty-six and seven-tenths* pounds, and the diffusers, under similar conditions, secured *seventy-nine and nine-tenths* pounds of sugar from each ton of cane, it follows that *mill products must be increased by seventy-two per cent. before they can equal diffusion products in quantity; in quality, however, these products are practically of equal value.*

3.

DIFFUSION UNDER UNFAVORABLE CONDITIONS.

During the week ending October 30th, four hundred and twenty tons and seven hundred and sixty pounds of unstripped and untopped cane were charged against the sugar-house.

The weather during two days of this week was bright and fair, but it was necessary to cut the cane in the fields before the heavy dew had evaporated. Rain fell incessantly upon the other four days. The work, however, was pushed forward as usual. The result was:

1st. That the sorghum was cut and loaded while dripping wet, and then drawn several miles to the scales in pouring rain. The recorded weights, therefore, are no indication of the amount of clean, dry cane delivered at works.

2d. The leaves, wet either with dew or rain, matted and tangled the cane sections so that the fan worked under disadvantages. The wet leaves also clung to all exposed surfaces and necessitated a stronger air blast to remove them; this increased the mechanical losses of cane, many of the lighter pieces being carried away with the leaves. In spite of the increased air blast much leaf was also carried into the diffusers, not only occupying the space which should have been filled with cane, but also blackening the diffusion juice and imparting to it a peculiar "tea" taste and smell.

It required *four hundred and forty-eight* diffusers during this week to work the cleaned product from *four hundred and twenty* tons of wet unstripped and untopped sorghum, when *four hundred and twenty* diffusers were sufficient for *four hundred and twenty* tons of cane under ordinary circumstances.

During this period, the average composition of the feed for pan was:

Per cent. of sugar.	Brix at 14°.	Purity.
33.01	57.33	57.6

The melada from this product was thoroughly unsatisfactory, the sugar boiler having experienced the greatest difficulty in securing grains and handling his pan. In the "hot room," the contents of the sugar wagons remained soft, and when this melada was worked through the centrifugal machines the yields of sugar were very small, being only *forty-four and three-tenths* pounds of 83 test per ton of cane. The molasses yield was, of course, correspondingly increased, amounting to *eight and three-tenths* gallons per ton.

Owing to the unfair conditions under which the cane was weighed, and also because of mechanical losses of cane sections during the fanning process, the above record of yields per ton have but little absolute significance. Relatively, however, they are of very marked interest.

The molasses, viz., eight and three-tenths gallons, weighed ninety-four and one-half pounds, of which 26.6 per cent., or twenty-five and two-tenths pounds, was found to be chemically pure sugar.

The crystallized product, viz., forty-four and three-tenths pounds, was 83 per cent. test, and represented, therefore, thirty-six and eight-tenths pounds of 100 test sugar.

94.5 pounds molasses.......... @ 26.6 = 25.2 ℔s. 100 test sugar.
44.3 " 83 test sugar...... = 36.8 " " "
Total. ....62.0 " " "

Under the conditions which governed this work, therefore, each ton of unstripped and untopped cane yielded *sixty-two* pounds of 100 test sugar, of which *fifty-nine and three-tenths per cent.* crystallized, and *forty and seven-tenths per cent.* remained in the molasses.

That this cane was practically of the same quality as that used in the preceding trial may be seen from the following examinations. A sample of cane was milled after it had been stripped of its wet leaves, sheaths and seed tops. The polariscope indicated 9.46 per cent. of sugar in the mill juice, equivalent to *one hundred and twenty* pounds per ton of unstripped and untopped cane, providing this cane had been harvested under ordinary conditions, for under ordinary conditions each ton of such cane contains 75 per cent. of clean stalks, of which 85 per cent. is juice.

COMPARISON OF THE DIFFUSION RESULTS SECURED UNDER FAVORABLE AND UNFAVORABLE CONDITIONS.

Conditions Unfavorable.

1. When sorghum is harvested while wet either with dew or rain, a single fanning is not sufficient to remove the leaves and leaf sheaths.

2. Leaves and leaf sheaths interfere seriously with the concentration, color and purity of diffusion juices. The average purity of the feed for pan secured under such conditions was 57.6° only.

3. With such "feed for pan" the sugar boiler experienced great difficulty in securing grain.

4. The melada remained soft even after eight days' storage in the hot room.

5. The centrifugal machines sparated from this product 2.12 pounds of molasses for each pound of 83 test sugar.

6. This molasses was inferior in color and taste.

7. Of the total sucrose in the melada *fifty-nine and three-tenths per cent.* crystallized in the form of merchantable sugar, and *forty and seven-tenths per cent.* remained in the molasses.

8. This molasses contained practically no invert sugar.

Conditions Favorable.

1. When sorghum is harvested in fair weather, particularly after a light frost, a single fanning will remove most of the leaves and leaf sheaths. Double fanning, however, is advisable, even under these conditions.

2. The average purity of the pan feed from well cleaned cane was 69.1°.

3. With such feed for pan, care was necessary on the part of the sugar boiler to prevent sugar from crystallizing on the steam coils in the vacuum pan.

4. The melada, after forty-eight hours' storage, could scarcely be indented with the hands.

5. From this melada the centrifugal machines separated 1.33 pounds of molasses for each pound of 83 test sugar.

6. The color of this molasses was excellent.

7. Of the total sucrose in the melada *sixty-nine and seven-tenths per cent.* crystallized into merchantable sugar, and *thirty and three-tenths per cent.* remained uncrystallized in the molasses.

8. This molasses contained practically no invert sugar.

From the above summary it appears that *sixty-nine and seven-tenths per cent.* of the sugar in the melada crystallized under favorable conditions, and *fifty-nine and three-tenths per cent.* only crystallized under unfavorable conditions.

The following calculations will illustrate the significance of these figures:

During a season of sixty days the Rio Grande house could be arranged to work *nine thousand tons* of unstripped and untopped cane. If this cane were similar to that worked during the past fall, and contained *one hundred and twenty* pounds of sugar per ton, then *ninety* per cent. or one hundred and eight pounds of this sugar should be secured in the melada. If the conditions under which the cane was worked were favorable, then *sixty-nine and seven-tenths per cent.* of the *one hundred and eight* pounds, or seventy-five and three-tenths pounds, should be found in the form of merchantable sugar, and thirty per cent., or thirty-two and seven-tenths pounds, would then exist in ten and one-half gallons of molasses; seventy-five and three-tenths pounds of 100 test are equivalent to ninety-four pounds of 80 test sugar; therefore, the nine thousand tons of cane should yield—

846,000 pounds of 80° test sugar.
94,500 gallons of 38° Baume molasses.

Under unfavorable conditions fifty-nine and three-tenths per cent. of one hundred and eight pounds would crystallize. This is equal to sixty-four pounds of 100 test or eighty pounds of 80 test sugar per ton. The molasses from each ton under such conditions would then contain forty and seven-tenths per cent. of one hundred and eight pounds or forty-four pounds of 100 test sugar, equivalent to fourteen gallons of 38° Baume. Nine thousand tons would, therefore, yield—

720,000 pounds of 80° test sugar.
126,000 gallons of 38° Baume molasses.

Leaves, therefore, which a single fan could not remove during wet weather, would introduce into diffusion juices impurities enough to prevent the crystallization of 126,000 pounds of sugar, and would thereby increase the yield of molasses by 31,500 gallons.

A fair cash market can readily be found for raw sugar. The packages, too, in which such sugar can be shipped are relatively inexpensive; for instance, sixty-three hogsheads, worth eighty-five cents each, would be sufficient for 126,000 pounds; the total outlay for packages in this case would thus be $53.50.

Large quantities of molasses cannot be readily sold. The expenses for barrels, too, are relatively heavy; 31,500 gallons would require six hundred and thirty, worth one dollar each.

The shipment of molasses, therefore, costs nearly twelve times as much as the shipment of sugar.

The aim at Rio Grande, consequently, is to secure the largest possible amount of the available sugar in crystalline form, reducing the molasses yield to a minimum.

The above reasoning indicates that in this direction success within certain limits will depend upon the thoroughness with which the cane is stripped and topped.

III.

THE CHANGES AND IMPROVEMENTS NEEDED IN ORDER TO INCREASE RECEIPTS AND DIMINISH EXPENSES.

1. *Removal of the leaves and sheaths.*
2. *Shredding the cane.*
3. *Concentration of diffusion juices.*
4. *Bagasse.*
5. *Storage of cane.*

1.

REMOVAL OF THE LEAVES AND SHEATHS.

The results which were secured by diffusion under unfavorable conditions have been given in detail.

It is immaterial whether such a result is caused by rain, by dew, or by any other agent; if satisfactory returns are desired, provision must be made to strip and top cane under any condition which is liable to exist.

Experience has indicated that something may be gained by cutting the cane into two-inch instead of four-inch lengths, before elevating it to the fan. It has also taught that two fans are necessary, one placed above the other, each being provided with a properly constructed attachment for arranging the leaf and cane before subjecting them to the air blast.

All of these points have been carefully studied, and the necessary machinery can be constructed without involving serious expenditure.

2.

SHREDDING THE CANE.

It has been shown on a previous page that thirty per cent. of the total sugar was lost in the bagasse and waste-water from the diffusion battery.

The cause of this loss lies in the size of the diffusion chips, as the following experiment, made by Superintendent Hughes, clearly illustrates.

Upon the 23d of October a large sample was drawn from the diffusion bagasse and separated into three grades, viz., coarse, medium and fine.

A sample of each was milled and the juice polarized with the following result:

	Per cent of sugar.	Brix at 14° R.	Purity.
Coarse	3.15	4.26	73°
Medium	2.00	2.46	81°
Fine, not pulped	0.96	1.46	67°

Assuming that the bagasse weighed the same as the fresh cane, and contained eighty-seven per cent. of juice, then the following calculations can be made:

Coarse chips	100	:	87	: :	3.15	:	2.80
Medium chips	100	:	87	: :	2.00	:	1.74
Fine chips	100	:	87	: :	0.96	:	0.84

That is, two and eight-tenths per cent. of the coarse chips, one and three-quarters per cent. of the medium, and eighty-four hundredths per cent. of the fine, respectively, was sugar, and as this cane had been found to contain 7.65 per cent. of total sucrose, it follows—

$$\frac{2.8}{7.65} = 36.6 \text{ per cent.} \quad \frac{1.74}{7.65} = 22.7 \text{ per cent.} \quad \frac{0.84}{7.65} = 11 \text{ per cent.}$$

That the coarse chips in the bagasse still carried *thirty-six and six-tenths* per cent., while the fine carried eleven per cent. only of the total sugar produced by the plant.

The sugar lost in the medium grade, viz., twenty-two and seven-tenths per cent., corresponds closely with the average loss in the mixed bagasse.

This is shown from the following trial: While the cane was being packed into diffusers, samples were drawn, dried, ground to a flour, extracted with alcohol and polarized after proper clarification. Calculated upon the stripped and topped basis, this cane was found to contain 7.65 per cent. of sugar. The bagasse from this cane was treated in a similar manner; upon the same basis, it was found to contain 1.93 per cent. of sugar. It follows, therefore, that, upon the average, this bagasse contained 25.2 per cent. of the total sugar produced in the fields.

The two knives used in chipping the cane were doubtless worked above their capacity, each cutting from forty to fifty tons daily. If four had been used instead of two, the cutting bars might have been adjusted so that the chips would have corresponded in size with those graded "fine" by Mr. Hughes, and an extraction of *ninety* per cent. thereby secured without decreasing the daily output of the works.

3.

CONCENTRATION OF DIFFUSION JUICE.

The comparison between milling and diffusion under ordinary conditions proved that, in concentration, mill juice from unstripped cane excelled diffusion juice from stripped cane. This result is radically different from the conclusions reached last season, when experiments upon a small scale proved that diffusion juice from stripped cane was more concentrated than mill juice from unstripped cane. The cause is believed to exist solely in the trouble experienced in properly filling the diffusion cells.

An attempt was made to pack them as silos are packed, viz., by treading the cane into all the corners and angles with the feet. The difficulties encountered were due chiefly to heat and impure air in the cells, it being clearly improper to ask men to work in such an atmosphere. One man was found, however, willing to make the attempt, and five cells were packed with the feet. The juice from these cells gave:

Sugar.	Brix.	Purity.
8.02 per cent.	12.81	62.6

Later in the day, when the ordinary method of working was practiced, the records show:

Sugar.	Brix.	Purity.
6.30 per cent.	10	63

This experiment indicates a very considerable gain due to the methods of packing, and better work could, of course, be accomplished if the cells were thoroughly ventilated and cooled with an air-blast.

Improvement in the shape and construction of the battery seems necessary, however, before thoroughly satisfactory and economical work can be done; for instance, an experiment upon a small scale, under conditions which admitted of a perfect control of water used, gave the following:

Sugar.	Brix at 14° R.	Purity.
9.63 per cent.	14.31	67.3

The average analysis of mill juice from unstripped cane was:

Sugar.	Brix at 14° R.	Purity.
8.93 per cent.	12.99	68.75

The diffusers, therefore, working upon an experimental scale, gave the more concentrated product, and it is evident that no good reason exists for the dilute juices secured during the past year, the construction of the battery and the manner in which it was manipulated being the sole cause of the increased evaporation expenses.

Plans have been already matured for a radically different application of the principle involved in this process, which will, it is believed, allow of the complete control of the water used and guarantee a more concentrated product.

4.

BAGASSE.

During the civil war considerable sorghum was grown near Philadelphia, largely for the bagasse, which then commanded high prices as paper stock. Since that time attention has been frequently directed toward this product, particularly by Dr. Collier, who announced a few years ago that pulp made from the bagasse of stripped cane was valued at 4½ cents per pound, by a practical paper maker.

In 1883, the Rio Grande Sugar Company sought expert opinions on this question, and learned by experiment that pulp from their mill bagasse ranked next to that from linen rags.

A scarcity of water at the sugar-house, a pressure of work in other directions, and the heavy expense of removing the coloring matters introduced by the leaves prevented the erection of proposed pulping works.

The annoyance and expense caused by the present method of handling bagasse, as well as the absolute necessity of the strictest economy in all branches of the sugar business, again directs attention to this product.

The diffusion bagasse must now be free from leaf contaminations, and one of the greatest obstacles to financial success in pulping it has therefore been removed.

A recent analysis of this bagasse, made at this Station, gives results which, when calculated upon the basis of stripped and topped cane, indicates 5.5 per cent. of crude fiber.

It has been already stated that the Rio Grande Works can be equipped to handle nine thousand tons of unstripped and untopped cane in sixty days ; the bagasse from this cane would therefore contain, approximately, *eight hundred thousand* pounds of crude fiber which could be worked into pulp, worth to-day at least three cents per pound. The expense and wastes incidental to this work are at present unknown, but the fact remains that thousands of dollars' worth of paper stock is now, at a very considerable expense, used to increase the size of compost heaps.

5.

STORAGE OF CANE.

Beets can be stored in cold weather for several weeks without noticeable depreciation in value to the sugar manufacturer. Sorghum, on the other hand, must be worked as soon as possible after it is harvested, for delays involve risk of serious losses.

Sorghum sugar manufacturers are therefore obliged to invest large amounts of capital in machinery in order to work rapidly. This machinery lies idle nearly ten months each year, and the difficulty of making the investment profitable is consequently very much increased.

It is evident that one of the most needed improvements at present is some method of preserving cane which will admit of its use in sugar manufacture during the winter, when good labor is both abundant and cheap.

One plan, recently proposed by Prof. Swenson, is to provide storage tanks in which juice limed to alkaline reaction may be kept until needed.

Another suggestion frequently made in the past has been to provide silos in which cane, stripped, topped and shredded ready for the diffusers, may be stored and used at the convenience of the sugar boiler.

Both plans seem reasonable and both should be carefully studied in all future experiments aimed at the development of this industry.

IV.

FINANCIAL CONSIDERATIONS.

Three years ago it was clearly seen that the Rio Grande Company failed to secure one-half of the total amount of sugar present in its sorghum crops, and since that time all energies have been directed toward the substitution of diffusion for milling. The obstacles to this change, met at the very beginning, have at last been overcome, and *seventy per cent.* of the sugar in the cane has this year been extracted and sold. Information has also been gained which shows how *ninety per cent.* of the total sugar may be secured in the future.

It still remains to be demonstrated that this industry can be made a financial success.

In order to meet insurance, taxes, wear and tear upon machinery, and interest upon the capital invested in the Rio Grande Sugar Co., an annual cash balance of nearly thirty thousand dollars must remain in the treasury after all of the season's expenses have been paid. At present market prices there is not enough sugar in the cane from one thousand acres of this plantation to admit of such a balance.

The experience and experiments of this company have of course shown how another plantation and house of the same size could be equipped and managed with very much less capital, and with a corresponding improvement in its chances of financial success. Both Superintendent Hughes and the chemist of this Station believe that the sorghum sugar business can be made profitable, and claim that the correctness of this opinion may be demonstrated by a house equipped to work fifteen tons of cane daily.

Specifications for such a house have been already prepared by Mr. Hughes. The plans call for boilers, diffusers and evaporating apparatus of *one-tenth* the capacity of the Rio Grande plant. Noticeable differences, however, appear in the relative proportions of other machines—for instance, the section and topping knife, in this plan, indicates *one-fifth*, the shredding knife indicates *one-half*, and fans indicate *twice* the capacity of those used last season in working from 80–90 tons of cane daily. Cane elevators, which last season proved to be the chief source of delay and expense, have been abandoned, expensive pumps and pipe fittings have also been studiously excluded; in short, this house is planned to include only such machines and appliances as have been found profitable during the past five years. The amount of money, therefore, necessary to build and equip it will not exceed *five thousand dollars.*

Financial success involves also the study of field management. Questions of especial importance are, the varieties of sorghum, suitable fertilizers, the proper number of hills per acre, the period of growth at which the maximum amount of sugar *per acre* is available, the length of the season and the storage of cane for use during the winter. All of these questions can be properly studied in connection with a house of the proposed capacity without involving an area of more than eighty acres of land, or an additional expenditure of more than *six thousand* dollars. All of which should be recovered from the sales of sugar, seed and molasses, provided the crop ranks in quality with that of 1885 and meets the present *expectations* in regard to quantity, as the following calculations indicate:

120,000 pounds of raw sugar,	@ 4 cents =	$4,800 00
12,000 gallons of molasses...	@ 20 cents =	2,400 00
1,500 bushels of seed.........	@ 40 cents =	600 00
Total.................		$7,800 00

It is well known that the tendency in tropical cane countries is toward central stations, consequently it may seem strange that small houses should be advocated for the sorghum sugar industry; indications, however, point to this plan as the one best suited for its development and introduction.

The proper management of a farm involves the rotation of crops, and sorghum can be grown in the place of corn wherever it can be shown to be the more profitable plant.

Five thousand dollars can be secured in nearly every farming community, provided security and a fair rate of interest can be guaranteed; and half a dozen farms in one neighborhood could easily provide eighty acres of land upon which to raise the crop.

This plan involves, of course, the presence in a community of a farmer capable of managing such a house, and one of the most thoughtful features in the above plan is the provision made for instructing and training active young men who may be sent, to learn the art of sugar making, by those who contemplate entering into this business.

The amount necessary to carry out this idea, viz., *eleven thousand dollars*, seems small in comparison with the enormous sums already invested by individuals and by the State and National Government, particularly as all of the valuable information already gained from these investments seems to be concentrated in this plan. It is therefore hoped that a thorough trial will be made under conditions which will admit of a detailed report to the public at the earliest possible moment.

FIELD EXPERIMENTS, UPON THE GROWTH OF SORGHUM, MADE AT RIO GRANDE, CAPE MAY COUNTY.

I. The effects of commercial fertilizers:
    Upon the stand of cane.
    Upon the growth of cane.
    Upon the yield of sugar per acre and per ton of cane.
II. The number of hills per acre.
III. At what stage in its development should sorghum be harvested.

Relative to the capacity of the sugar-house, the area of arable land in the Rio Grande plantation is too small to admit of a rotation of crops. Consequently, the management of the farms is one of the most serious problems connected with this undertaking.

The trials with various fertilizing materials, made during the year 1885, indicated clearly that upon this soil and crop potash was the most profitable form of plant-food available; it was further shown, however, that potash accomplished its best work when used in combination with nitrogen.

The experiment was continued upon the same ground in 1886, without changes or modifications of any kind. For the second time, therefore, plot 2 was dressed with nitrate of soda, plot 3 with phosphoric acid, plot 4 with muriate of potash, plot 9 with two tons of stable manure, &c., &c.

The following description is copied from the last annual report:

"The field selected for this experiment is level, uniform in quality and protected from northeast storms by a heavy strip of woodland several hundred feet distant.

"Its soil is a very sandy loam, easily worked and responsive to fertilizers. For several years in succession it has been cropped with sorghum, but has never been rated high in fertility.

"Before arrangements were made for this trial the field had been dressed with a compost made of four tons of mill bagasse to one ton of yard manure. This had been spread uniformly at the rate of five tons per acre.

"A tract five hundred and forty-eight feet long and one hundred and forty-five feet broad was accurately measured by a surveyor. Lanes four feet wide separated it, on either end, from the rest of the field; on one side it was bounded by a farm road and on the other by a fence. A headland, nearly eight feet wide, was left along this fence, principally to give the farmer who cultivated this field an ample opportunity to turn his horses without breaking down the young cane at this end of the rows; the farm lane answered a similar purpose at the other end.

"This tract was first prepared as if intended for Indian corn. By means of lanes four feet wide it was then divided into sixteen plots, each one-tenth of an acre in area.

"The fertilizers were sown broad-cast and harrowed in; the quantities and combinations used upon each plot, as well as the cost of the material, can be found in the following table. As in former experiments made by this Station, phosphoric acid was used in the form of bone-black superphosphate, and nitrogen in the form of nitrate of soda; muriate of potash was applied to some of the plots and sulphate of potash to others. Two tons of yard manure were spread upon plot 9, and forty pounds of land plaster upon plot 15. Two plots, Nos. 1 and 16, were left without fertilizers, in order to learn what the soil alone was able to produce."

Early Orange seed was planted in hills during the first week in May; these hills were three feet six inches apart, and each contained five stalks.

As was stated in the last annual report, plot 1 was located too near the site of a former compost-bed, as two or three of its outer rows clearly indicated. The records for this plot are, therefore, excluded, and all comparisons as to the effects of the fertilizers must be drawn against plot 16. By mistake, barn-yard manure was this year spread upon plot 10 instead of on plot 9. This was noticed immediately, however, and plot 9 was then properly dressed. This mistake excludes plot 10 also from the record.

I.

The Effects of Commercial Fertilizers upon the "Stand" of Sorghum.

As far as can be ascertained, the stand of cane at first was practically perfect upon all of the plots, but during the warm weather in June more than half of the hills upon plots 1, 2, 3, 5, 15 and 16 were destroyed—"scalded out"—according to the testimony of the Cape May farmers. Corn, in many sections of this county, suffering in a similar manner.

The plots mentioned above are the only ones in this experiment upon which no potash was used. They are, too, the only ones upon which the stand of cane at the harvest was noticeably imperfect. Their relative positions in the field seem to have been without influence upon this result. An excellent stand, for instance, existed upon plot 4, which was bounded by two very poor plots, viz., No. 3, fertilized with bone-black superphosphate, and No. 5, fertilized with bone-black superphosphate and nitrate of soda.

The muriate of potash plot, No. 4, yielded more than nine tons of excellent cane per acre. Plot 3, on the other hand, gave but two tons, and plot 5 three tons only per acre. Plots 15 and 16, located at the other end of the field, were also seriously affected, and averaged only one ton each per acre.

It has been noticed that this blight occurs during hot weather, particularly when the sun shines brightly after a short shower near midday.

A practical man at Rio Grande states, that scalded canes have a dark ring around them very near the ground; if the stalk is small, a quarter of an inch or less in diameter, this dark circle extends quite through it; a condition invariably followed by death. If, however, the stalk is thick, the ring extends only a short distance into it, and very often the plant recovers. He claims that potash develops cane of large diameters, hence the escape of plots fertilized with this element.

Whatever the cause or nature of this "scald," the fact remains that potash, either in the form of muriate or high grade sulphate, proved to be a serviceable remedy in this experiment.

Season of 1885. Seed Planted April 22d.

RIO GRANDE PLANTATION. EARLY ORANGE SORGHUM.

Weekly Record of Development, Expressed in Inches.

Fertilizers. Kind and Quantity Used per Acre.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						Potash as Muriate.				Potash as High Grade Sulphate.						
		Nitrogen, 22.50 lbs. from Nitrate of Soda.	Phos. Acid, 52.50 lbs. from Bone Black Superphos.	Potash, 75.00 lbs. from Muriate of Potash.	Nitrogen, 22.50 lbs. Phos. Acid, 52.50 "	Nitrogen, 22.50 lbs. Potash, 75.00 "	Phos. Acid, 52.50 lbs. Potash, 75.00 "	Nitrogen, 22.50 lbs. Phos. Acid, 52.50 " Potash, 75.00 "	Barn-yard Manure, 20 Tons.	Potash, 80.00 lbs. from Sulphate of Potash.	Potash, 80.00 lbs. Phos. Acid, 52.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 " Phos. Acid, 52.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 " Phos. Acid, 105.00 "	Land Plaster, 400 lbs.	No Fertilizer.
		In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
June 2d	....	2.50	2.75	2.75	2.25	2.50	2.25	2.50	3.00	2.50	2.25	2.50	2.50	2.50	2.00	2.50
June 9th	....	3.50	3.50	4.50	3.50	3.50	3.25	3.50	4.00	4.00	4.00	3.75	4.00	4.00	3.50	3.25
June 16th	....	5.50	4.50	5.00	4.50	5.00	5.00	4.50	5.50	5.00	5.00	4.50	5.00	6.00	4.50	4.00
June 23d	....	11.00	9.00	10.00	9.00	12.00	10.00	10.00	12.00	9.00	9.00	10.00	11.00	13.00	8.00	8.00
June 30th	....	18.00	14.00	14.00	14.00	18.00	14.00	15.00	19.00	14.00	14.00	15.00	18.00	22.00	12.00	13.00
July 7th	....	29.00	23,00	23.00	24.00	27.00	25.00	26.00	30.00	23.00	27.00	26.00	28.00	31.00	21.00	21.00
July 14th	....	36.00	31.00	28.00	29.00	35,00	32.00	31.00	35.00	29.00	31.00	34.00	33.00	39.00	28.00	27.00
July 21st	....	52.00	44.00	41.00	37.00	46.00	37.00	44.00	50.00	37.00	44.00	44.00	48.00	51.00	32.00	34.00
July 28th	....	72.00	56.00	57.00	53.00	62.00	56.00	62.00	66.00	55.00	59.00	61.00	61,00	67.00	42.00	45.00
August 4th	....	80.00	67.00	70.00	63.00	73.00	66.00	75.00	79.00	68.00	69.00	75.00	76.00	80.00	53.00	55.00
August 11th	....	89.00	80.00	90.00	76.00	92.00	77.00	87.00	90.00	85.00	82.00	90.00	87.00	90.00	60.00	68.00
August 18th	....	103.00	96.00	103.00	86.00	104.00	91.00	97.00	100.00	100.00	96.00	100.00	100.00	107.00	67.00	76.00
August 25th	....	113.00	106.00	116.00	100.00	114.00	100.00	107.00	109.00	109.00	106.00	114.00	110.00	118.00	84.00	86.00
No. tons unstripped and untopped cane harvested per acre	....	19.11	17.17	19.59	18.83	22.19	19.91	19.96	17.53	16,82	16.89	17.03	17.18	16.21	9.81	10,17

Season of 1886. Seed Planted During First Week in May.

RIO GRANDE PLANTATION. EARLY ORANGE SORGHUM.

Weekly Record of Development, Expressed in Inches.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						Potash as Muriate.				Potash as High Grade Sulphate.						
FERTILIZERS. KIND AND QUANTITY USED PER ACRE.		Nitrogen, 22.50 lbs. from Nitrate of Soda.	Phos. Acid, 52.50 lbs. from Bone Black Superphos.	Potash, 75.00 lbs. from Muriate of Potash.	Nitrogen, 22.50 lbs. Phos. Acid, 52.50 "	Nitrogen, 22.50 lbs. Potash, 75.00 "	Phos. Acid, 52.50 lbs. Potash, 75.00 "	Nitrogen, 22.50 lbs. Phos. Acid, 52.50 " Potash, 75.00 "	Barn-yard Manure, 20 Tons.	Potash, 80.00 lbs. from Sulphate of Potash.	Potash, 80.00 lbs. Phos. Acid, 52.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 " Phos. Acid, 52.50 "	Potash, 80.00 lbs. Nitrogen, 22.50 " Phos. Acid, 105.00 "	Land Plaster, 400 lbs.	No Fertilizer.
		In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
June 9th	....	3.50	3.00	4.50	3.50	4.00	4.00	4.00	4.00	....	4.00	4.50	4.00	4 25	3.00	3.50
June 16th	....	5.00	4 00	6.00	6.00	6.00	6.00	6.00	6.00	....	6.50	7.00	6.00	6.50	4.25	4.75
June 23d	....	7.00	6.50	10.00	8.50	10.00	10.00	9 00	9 50	....	9 50	11 00	10.25	10.00	5.75	6.00
June 30th	....	9.50	7.50	13.00	12 50	16.00	15.00	15.00	16.00	....	15.50	17.50	18.00	18.00	9.00	9.50
July 7th	....	13.50	10.00	19 50	15.00	23.00	21.00	25.00	27.20	....	24.00	25.20	27.00	25 20	8.50	10.00
July 14th	....	23.00	16.00	32.00	26.00	32.00	31.00	34.00	38.00	....	34.00	36.00	36.00	36.00	17.00	20.00
July 21st	....	34.00	30.00	41.00	33.00	46.00	41.00	46.00	50.00	....	44.00	46.00	49.00	51.00	20.00	23.00
July 28th	....	39.00	36.00	57.00	42.00	55.00	56.00	60.00	67.00	....	59.00	60.00	62.00	66.00	34.00	36.00
August 4th	....	49.00	47.00	62.00	53.00	63.00	62.00	68.00	74.00	....	65.00	68.00	68.00	70.00	44.00	46.00
August 11th	....	55.00	55.00	67.00	61.00	70.00	65.00	73.00	87.00	....	74.00	70.00	75.00	75.00	60.00	60.00
August 18th	....	68.00	67.00	80.00	70.00	85.00	77.00	89.00	100.00	....	88.00	88.00	90.00	90.00	60.00	70.00
August 25th	....	90.00	76.00	98.00	80.00	100.00	90.00	107.00	112.00	....	100.00	100.00	100.00	100.00	80.00	80.00
No. tons unstripped and untopped cane harvested per acre	....	4.21	2.02	9.29	3.62	10.97	8.4	9.27	10.66	....	8.09	8.60	8.10	8.30	0.77	1.2

The Effect of Fertilizers Upon the Growth of Sorghum.

Plots Nos. 1, 2, 3, 5, 15 and 16, for the reason just given, are excluded from the comparison. A remarkable uniformity in development characterizes the remaining plots; slight variations occurred, of course, during the period under observation, but no one fertilizing element or combination of elements appears noticeably superior. At the date of the last measurement, August 25th, the range of variations was from 98 inches to 112 inches. The tallest cane, however, failed to yield crops proportionally heavy. For instance, the cane upon plot 9 was one foot taller than that upon plot 6, yet the latter plot gave the heavier yield per acre. Again, the cane upon plot 8, in comparison with that upon plot 4, excelled by seven inches, but the crop returns from each were practically identical in weight.

The comparison of the records of 1885 and 1886 indicates that a difference of two weeks in dates of planting exercised no marked influence. Upon the 9th of June, for instance, the measurements for both years are nearly the same. Excluding plots 2, 3, 5, 15 and 16, it will be noticed that upon the 28th of July the measurements for both years again agree in a remarkable manner, the only exception being plot 6. After this date, however, the development in 1886 became much slower, plots 8 and 9 only comparing favorably with their record for the previous year. Possibly a cause for this may be found in differences in temperature, but data relating to the degree of heat best suited for sorghum-development at this stage of its growth cannot at present be found. The Rio Grande record is as follows:

	1883.	1884.	1885.	1886.
Mean temperatures for month ending July 28th	75.5°	76.8°	79.0°	75.9°
Mean temperatures for month ending August 25th	76.8°	74.7°	77.2°	71.6°

The temperature during August, 1886, therefore, is noticeably lower than that for any previous year here recorded.

The Effects of Fertilizers Upon the Yields of Sugar Per Acre and Per Ton of Cane.

The methods followed last season, both in securing field-samples of the crop and in determining their percentages of sugar, were again used this year. They are as follows:

A row was selected near the center of a plot and all canes, large and small, cut out until a bundle was secured which approximated seventy-five pounds in weight. Every plot was sampled in this manner on the 4th of November, under the personal supervision of Superintendent Hughes and the chemist of this Station.

After the leaves, sheaths and seed tops had been removed from a sample and weighed, the clean canes were cut into half-inch pieces and shredded in a Lion cutter and crusher. A sub-sample was then drawn, dried at 120° Fah., and ground in a mill until fine enough to pass a sieve twelve meshes to the inch. In this sample the sugar was separated from the fiber by means of boiling alcohol, and after the removal of the alcohol the extract was purified with basic lead acetate and polarized according to Clerget's method. The results have been tabulated and arranged for comparison upon a subsequent page.

EXPLANATION OF THE FOLLOWING TABLE.

In the past the analytical results have been studied from five standpoints:

1. To what extent and at what expense has sugar production been increased by fertilizers.
2. Is the increased amount of sugar per acre due to improvements in the quality or to gains in the quantity of cane.
3. What element exerts most marked influence upon sugar production.
4. What effect followed the use of phosphoric acid.
5. Is the sulphate or the muriate of potash to be preferred in the cultivation of sorghum.

By comparing the yields from plot 16 with those from each of the other plots, it is evident that enormous gains could with justice be claimed from the use of fertilizers, both in regard to the quality and quantity of cane. The first and second questions will not be further discussed in this report, however, the ruling conditions this season having clearly been exceptional.

3.

What Element Exerted Most Marked Influence Upon Sugar Production.

In every case where potash was used a good stand of a fair quality of cane was secured. Wherever potash was not used cane relatively low in its percentage of sugar was grown, the "stand," too, in all cases being very poor. The conclusion is, therefore, that potash was the element which exerted most marked influence upon sugar production.

4.

What Effect Followed the Use of Phosphoric Acid.

By comparing plots 2, 3 and 4 it will be evident that phosphoric acid exerted a less favorable influence upon sugar production than either nitrogen or muriate of potash. When phosphoric acid was used in combination with nitrogen, plot 5, the yield of sugar fell below that from plot 2, upon which nitrogen alone was used; and when it was combined with both nitrogen and potash, it caused, in each case, a loss of more than three hundred pounds of sugar per acre. (Compare plots 8 and 13 with 6 and 12.) Further, when the amount of phosphoric acid was doubled, an additional loss of one hundred pounds of sugar occurred. (Compare 13 with 14.) With the exception of plot 7, phosphoric acid, in every case, positively decreased the yields of sugar per acre. These results are practically identical with those of last year and again corroborate the College Farm experiment made in 1883.

Phosphoric acid, however, must not be excluded from sugar plantations before its effects upon cane, early in the season, have been studied. It may be that its use would have been strongly advocated had this experiment been concluded in September instead of in November.

RIO GRANDE PLANTATION. EARLY ORANGE SORGHUM.

Tonnage of Cane and Yield of Sugar per Acre for 1885 and 1886.

FERTILIZERS. KIND AND QUALITY USED PER ACRE.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						Potash as Muriate.				Potash as High Grade Sulphate.						
RECORD FOR 1885.		Nitrogen, 22.5 lbs. from Nitrate of Soda.	Phosphoric Acid, 52.5 lbs. from Bone Black Superphos.	Potash, 75 lbs. from Muriate of Potash.	Nitrogen, 22.5 lbs. Phos. Acid, 52.5 “	Nitrogen, 22.5 lbs. Potash, 75.0 “	Phos. Acid, 52.5 lbs. Potash, 75.0 “	Nitrogen, 22.5 lbs. Phos. Acid, 52.5 “ Potash, 75.0 “	Barn-yard Manure, 20 Tons.	Potash, 80.0 lbs. from Sulphate of Potash.	Potash, 80.0 lbs. Phos. Acid, 52.5 “	Potash, 80.0 lbs. Nitrogen, 22.5 “	Potash, 80.0 lbs. Nitrogen, 22.5 “ Phos. Acid, 52.5 “	Potash, 80.0 lbs. Nitrogen, 22.5 “ Phos. Acid, 105.0 “	Land Plaster, 400 lbs.	No Fertilizer.
Cost of Fertilizers per acre	....	$4.05	$3.67	$3.00	$7.72	$7.00	$6.67	$10.72	....	$4.20	$7.87	$8.25	$11.92	$15.59	$1.50	....
Per cent. of Leaves and Seed Tops......................	....	21.80	21.70	20.50	24.40	18.80	19.30	19.00	18.40	21.00	14.00	19.20	20.80	22.00	24.00	23.00
Pounds of unstripped and untopped cane per acre...	....	38210	34330	39170	37650	44370	39820	39920	35050	33640	33770	34060	34350	32420	19610	20349
Per c. of Total Sugar in unstrip'd and untop'd cane.	....	7.18	7.56	7.48	6.57	7.29	7.14	7.50	6.26	7.50	8.19	8.30	7.54	7.46	6.46	6.17
Total amount of Sugar in pounds per acre......	....	**2744**	**2595**	**2930**	**2477**	**3234**	**2843**	**2994**	**2194**	**2523**	**2732**	**2830**	**2590**	**2419**	**1267**	**1255**
RECORD FOR 1886.																
Per cent. of Leaves and Seed Tops......................	....	22.70	25.60	22.20	27.50	20.00	20.00	16.30	18.80	....	18.60	18.10	20.30	25.00	27.10	25.40
Pounds of unstripped and untopped cane per acre...	....	8430	4040	18590	7250	21950	16800	18540	21330	....	16190	17210	16140	16760	1750	2380
Per c. of Total Sugar in unstrip'd and untop'd cane.	....	5.39	4.08	6.46	5.07	7.67	7.54	7.14	6.74	....	6.99	7.70	6.86	6.05	4.37	4.68
Total amount of Sugar in pounds per acre......	....	**454**	**165**	**1201**	**368**	**1683**	**1267**	**1324**	**1438**	....	**1132**	**1325**	**1107**	**1014**	**77**	**111**
Bushels of clean Seed per acre..............................	....	6.8	2.0	11.7	4.4	16.8	9.2	14.9	19.6	....	9.1	13.7	1.2	7.9	0.7	1.4
Bushels of Seed per ton of cane..............................	....	1.6	1.0	1.3	1.2	1.5	1.1	1.6	1.8	....	1.1	1.6	1.5	0.9	1.0	1.2

5.

Is the Sulphate or the Muriate of Potash to be Preferred in the Cultivation of Sorghum.

Under the conditions which existed this year the crops from the muriate of potash plots excelled those from the sulphate plots, both in quantity and quality.

CONCLUSIONS.

1. Of all the fertilizing elements tested, potash, in the form of muriate, exerted the most favorable effect upon the yield of sugar per acre; its best results being secured when it was used in combination with nitrate of soda.

2. For two years in succession plot 6 has been fertilized with nitrate of soda and muriate of potash; plot 9, during the same time, has been dressed with stable manure, applied each year at the rate of twenty tons per acre. The crop, both of cane and sugar, from plot 6 has each year noticeably surpassed that from plot 9. During this period, at an expense of *fourteen dollars* for fertilizers, plot 6 has yielded sugar at the rate of 4,917 pounds per acre; during the same period, at an expense of *sixty dollars* for manure, plot 9 has yielded sugar at the rate of 3,632 pounds per acre.

II.

THE PROPER NUMBER OF HILLS PER ACRE.

At the close of the grinding season in 1885 it was evident that the sorghum sugar industry depended upon the diffusion process, but it was also evident that the cane leaves and sheaths must be removed before this process could be successfully introduced.

The machine for stripping cane, partially developed at that time, could do its best work upon large stalks, hence an attempt was made, by wide planting, to secure a crop containing as few small canes as possible.

In the experiment made in 1885 the cane rows were three feet apart, with hills at intervals of two feet. The hills, therefore, numbered 7,260 per acre; each contained five stalks. In the experiment made upon the same ground with the same kind of fertilizers in

1886, the hills also contained five stalks each, but as these hills were planted three feet six inches apart they numbered 3,546 only per acre.

The crops in 1885 from plots 4, 6, 8, 12, &c., weighed in each case nearly twice as much as those harvested in 1886, the decreased yields being strictly proportional to the decreased number of hills per acre. Plot 9, however, upon which an excessive amount of barn-yard manure had been used for two consecutive years, formed an exception to this rule; wide planting in this case was followed by a marked decrease in yield, but not in direct proportion to the decreased number of hills. The hope, therefore, that the canes would make up in weight for their loss in number was not realized. Several weeks of actual work modified the stripping machine and adapted it for use either upon large or small cane. With regard to sugar-house requirements, therefore, the size of the stalk is no longer a matter of marked importance.

Narrow planting, it is true, involves, at present, an increased amount of hand labor and consequently larger pay rolls. This expense, however, is not proportional to the gains in the weight of the crop; relatively slight exertions, too, should be sufficient to overcome the difficulties which make this hand work necessary.

Taking everything into consideration, the testimony at present is decidedly in favor of narrow planting, at least upon this plantation; the proper number of hills per acre being probably 7,260, an allowance of six square feet per hill.

III.

AT WHAT STAGE IN ITS DEVELOPMENT SHOULD SORGHUM BE HARVESTED.

This question has been frequently discussed and possibly the correct answer has been given, if so, it has been expressed in a manner which robs it of its due weight among practical men.

The chemical analysis of cane, showing its percentage of sugar only, is far from reliable information on this question, if unaccompanied by the actual weight of crop per acre. A normal evaporation of water from a crop, for instance, may cause an apparent improvement in its quality, but as this evaporation is accompanied by a corresponding loss of weight, it leaves the absolute amount of sugar per acre unchanged. Again, the percentage of sugar in the juice may remain constant while the quantity of juice to be secured from an acre of cane may be steadily decreasing, involving thereby a loss in the absolute amount of sugar.

Such changes are probably occurring constantly, and farmers, whose entire work for sixty consecutive days consists in cutting and handling cane, have rough but suggestive methods for drawing comparisons. When loading green, juicy cane early in the season they compare it with lead pipes, later in the season the comparison is with dried corn-stalks. These variations escape a chemist who busies himself with the quality of the juice, for a ten-day average of analyses of juices at the beginning of the season may be almost identical with a similar average drawn at its close. If, however, the absolute quantity of juice per acre at the beginning and end of the season could be compared, striking results might be demonstrated.

Regarding these changes in the weight of the crop, the farm superintendent at Rio Grande, Mr. Wm. Hand, states that it was his custom early in the season to load ten slings full of cane upon each car for transportation to the sugar-house. This caused the trackmaster much work, and finally he reported his inability to keep his track in repair. Some of the overloaded cars weighed 6,000 pounds. Later in the season fourteen slings full of cane were piled upon each of the cars, which then failed to average more than 4,000 pounds. This means that a bundle of cane early in the season weighs six hundred pounds, and later in the season a bundle of the same size weighs only three hundred pounds. Incredible as this may seem these results are firmly believed to be, approximately, correct by men who are in position to make the most reliable observations.

This loss is not due solely to evaporation of water, for that would be followed by yields of sugar twice as large as normal cane affords, on the contrary, this loss in tonnage seems to be accompanied by a very marked decrease in the average yields of sugar per ton, as the following statements indicate:

During the period October 9th–October 23d, seven hundred and twenty-eight tons of unstripped and untopped sorghum was diffused, and an average yield per ton of *eighty pounds* of 100° test sugar thereby secured. Of this eighty pounds fifty-five and seven-tenths pounds crystallized and twenty-four and three-tenths pounds remained in the molasses. This cane was grown principally upon banked meadows, and although it may have passed its best stage as regards sugar production, it was not considered "dried up" or pithy.

On the 1st, 2d and 3d of November, two hundred and forty-one tons of unstripped and untopped cane was diffused, and an average yield per ton of *fifty pounds* of 100° test sugar thereby secured, of which thirty pounds crystallized and twenty pounds remained in the molasses. This cane was grown upon upland which had been heavily dressed with stable manure. Early in the fall it was considered a first-class crop, and, as it was within easy reach of the sugar-house, it was held in reserve to be used in case any emergency made it difficult to secure the necessary supply from more distant fields. This sorghum affords an unusual example of an over-ripe, pithy crop.

The green cane yielded eighty pounds and the pithy cane fifty pounds of 100° test sugar per ton. If, therefore, this loss of sugar was accompanied by losses in tonnage as heavy as farmers claim, then milling wastes at once sink into comparative insignificance. For if one-half of the tonnage disappears, and if at the same time that portion of the crop which remains depreciates forty per cent. in value to the sugar boiler, it follows that *two-thirds* of the sugar formed in the plant may be wasted by delays in field-work.

This reasoning rests upon claims and assumptions which can be easily and thoroughly investigated; it indicates that the most important question now awaiting solution is, "at what stage in its growth should sorghum be harvested."

FODDERS AND FEEDS.

In the report of this Station for 1886 it was claimed that from five to eight million dollars' worth of feed and fodder is consumed annually in this State by milch cows alone. The methods which should be followed in feeding live stock were then considered in detail and illustrated by numerous examples which demonstrated the following points:

1. That if waste products from flouring and oil mills are properly mixed with corn stalks and straw, economical substitutes for hay and grain will be secured for dairy purposes.

2. That the proportions in which such products should be mixed depends upon their chemical composition; and that the introduction of this system of stock-feeding into general use involves, therefore, the preparation of tables giving the average analyses of the different grades of all feeding-stuffs and fodders.

The first step towards the preparation of such tables for this State was taken last season, when one hundred and twenty samples of *feeds* were analyzed, tabulated and compared with the results of similar work in other States and countries. This work has been continued, and the following tables contain the analyses of eighty-one different samples of *fodders*, all of which have been secured this year; the counties from which they were drawn, the names of the inspectors and the dates of the inspection being given in each case.

Contrary to the general custom, the ash from each sample has also been examined and the amount of potash and phosphoric acid present in each kind of fodder thereby determined. Farmers who know the weights of their crops per acre can, therefore, calculate for themselves the amount of plant-food drawn from their soil each year, and a very little additional study will indicate how much of it goes back to the fields in the form of stable manure, and how much of it is permanently lost to the farm by the sales of milk, grain, hay, &c.

Following last year's plan, the average analysis for each fodder has been tabulated at the close of this chapter. This affords an opportunity for comparing these results with German analyses, published by Professor Kühn, and American averages, collected and arranged by Dr. Jenkins.

Questions relating to the digestibility of fodders and feeds have been reserved for a future report. The samples analyzed this year represent twenty-five different kinds of fodders; for convenience in reference a list is tabulated below:

	Samples.
Clover Hay	11
Corn Stalks	11
Timothy Hay	10
German Millet, or Hungarian Grass	7
Oats Straw	7
Rye Straw	6
Wheat Straw	4
Lucern	3
Orchard Grass	3
Bag Hay	2
Salt Hay	2
Creek Sedge	2
Hungarian Grass Straw	1
Hungarian Grass Seed	1
Sweet Potatoes	1
Buckwheat Straw	1
Oil Meal	1
Timothy and Clover, mixed	1
Timothy, Red Clover and Alsike, mixed	1
Orchard Grass and Second Crop Clover, mixed	1
Hay from Banked Meadows	1
Herd Grass	1
Black Grass Hay	1
Short Sedge	1
Marsh Rosemary	1
Total	81

CLOVER HAY.

Station number.	Brand.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
341	Clover Hay	6.11	2.38	29.71	7.40	13.00	41.40	2.08	0.41	3.02
344	" " 2d Crop	7.12	2.87	25.82	8.33	13.81	42.05	2.21	0.36	2.93
366	" "	7.88	1.88	27.28	6.59	13.56	42.81	2.17	0.50	1.15
367	" " White Clover	7.08	2.10	27.25	8.95	14.06	40.56	2.25	0.25	1.06
368	" " Alsike	7.46	1.64	29.52	6.44	11.44	43.50	1.83	0.39	2.15
379	" " 2d Crop	8.45	1.75	27.65	6.71	13.00	42.44	2.08	0.37	1.91
380	" " 1st "	8.30	1.80	28.63	6.77	13.50	41.00	2.16	0.32	2.08
390	" "	8.52	2.03	23.74	6.18	10.50	49.03	1.68	0.29	1.08
406	" "	8.50	2.38	24.60	6.42	13.50	44.60	2.16	0.31	1.24
415	" "	7.56	1.82	30.38	6.05	10.38	43.81	1.66	0.46	0.68
428	" "	7.62	2.20	35.65	4.95	10.31	39.27	1.65	0.25	1.20
	Average	**7.70**	**2.08**	**28.20**	**6.80**	**12.46**	**42.77**	**1.99**	**0.36**	**1.68**

TIMOTHY HAY.

Station number.	Brand.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
353	Timothy Hay	8.67	1.62	30.30	4.20	9.19	46.02	1.47	0.31	0.90
357	" "	7.43	2.32	28.27	3.43	6.63	51.92	1.06	0.24	1.08
358	" "	6.47	1.98	24.55	3.77	6.50	56.73	1.04	0.35	0.81
361	" "	6.99	1.82	28.37	4.68	6.63	51.51	1.06	0.33	1.91
388	" "	7.43	1.83	29.25	4.85	6.19	50.45	0.99	0.25	1.32
394	" "	7.25	1.74	30.98	3.64	5.13	51.26	0.82	0.63	0.89
400	" "	7.50	1.77	27.63	4.93	7.31	50.86	1.17	0.33	1.71
414	" "	7.40	1.52	31.28	5.38	6.50	47.92	1.04	0.45	1.76
425	" "	6.12	1.78	27.71	3.56	3.75	57.09	0.60	0.38	0.91
431	" "	6.57	1.92	28.95	4.77	4.69	53.10	0.75	0.33	1.74
	Average	**7.18**	**1.83**	**28.73**	**4.32**	**6.25**	**51.69**	**1.00**	**0.36**	**1.30**

CLOVER HAY.

Station number.	BRAND.	COUNTY.	SAMPLED BY.	Date of Sampling.
341	Clover Hay, 1st Cut	Middlesex	Chemist of Station	July 1, '86.
344	" " 2d "	"	" " "	Aug. 26, '86.
366	" "	Burlington	H. I. Budd	Nov. 18, '86.
367	" " White Clover	"	" "	" " "
368	" " Alsike	"	" "	" " "
379	" " 2d Crop	Cumberland	Theo. F. Baker	Nov. 12, '86.
380	" " 1st "	"	" " "	" " "
390	" "	Salem	Joseph L. Duell	Nov. 19, '85.
406	" "	Ocean	John H. Irons	" " "
415	" "	Gloucester	Geo. B. Hurff	Nov. 18, '86.
428	" "	Cape May	Ephraim Hildreth	July 1, '86.

TIMOTHY HAY.

Station number.	BRAND.	COUNTY.	SAMPLED BY.	Date of Sampling.
353	Timothy Hay	Warren	Asst. Chemist of Station	Oct. 26, '86.
357	" "	Burlington	H. I. Budd	Nov. 18, '86.
358	" "	"	" "	" " "
361	" "	"	" "	" " "
383	" "	Cumberland	Theo. F. Baker	Nov. 12, '86.
394	" "	Salem	Reeves Flitcraft	Nov. 18, '86.
400	" "	Ocean	John H. Irons	Nov. 19, '86.
414	" "	Gloucester	Geo. B. Hurff	" " "
425	" "	Cape May	Ephraim Hildreth	Nov. 22, '86.
431	" "	Middlesex	Chemist of Station	July 3, '86.

HAY FROM GERMAN MILLET, LUCERN AND ORCHARD GRASS.

Station number.	Brand.	Pounds per hundred of						Percentage of		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
343	German Millet	7.10	1.83	30.25	6.70	6.19	47.93	0.99	0.33	1.31
352	“ “	9.05	1.70	27.35	5.03	12.25	44.62	1.96	0.32	0.94
381	“ “	8.28	2.19	25.65	7.46	12.00	44.42	1.92	0.35	2.11
386	“ “	8.14	1.68	23.58	6.72	7.06	52.82	1.13	0.37	0.99
388	“ “	7.28	1.45	29.92	5.48	5.94	49.93	0.95	0.30	0.96
399	“ “	7.65	1.90	27.81	6.11	5.00	51.53	0.80	0.51	1.27
430	“ “	6.78	1.68	28.15	5.75	4.69	52.97	0.75	0.29	1.41
	Average	**7.75**	**1.78**	**27.53**	**6.18**	**7.59**	**49.19**	**1.21**	**0.35**	**1.29**
338	Lucern, 1st Cut	7.55	2.40	26.22	8.61	18.56	36.66	2.97	0.43	2.60
342	“ 2d “	5.66	1.80	33.04	6.49	17.56	35.45	2.81	0.42	1.98
347	“ 3d “	6.25	1.96	31.38	6.19	15.00	39.22	2.40	0.34	1.72
	Average	**6.48**	**2.05**	**30.31**	**7.10**	**17.04**	**37.11**	**2.73**	**0.40**	**2.10**
370	Orchard Grass	6.88	1.36	36.47	3.93	3.63	47.73	0.58	0.23	1.14
387	“ “	6.53	2.42	29.74	6.11	6.63	48.57	1.06	0.26	2.08
392	“ “	7.32	1.67	30.70	5.48	6.88	47.95	1.10	0.36	1.70
	Average	**6.91**	**1.82**	**32.30**	**5.17**	**5.71**	**48.08**	**0.91**	**0.28**	**1.64**

CORN STALKS.

Station number.	Brand.	Pounds per hundred of						Percentage of		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
349	Corn Stalks, Dent	10.05	0.94	28.92	4.50	7.13	48.46	1.14	0.40	0.72
350	“ “ Yellow Flint	8.45	1.06	26.62	5.50	8.45	49.93	1.35	0.32	1.28
374	“ Fodder	8.44	1.68	25.22	8.08	9.56	47.02	1.53	0.41	1.14
376	“ “ Sweet	8.68	1.95	24.08	11.00	7.75	46.54	1.24	0.16	1.23
382	“ Stalks	7.86	1.10	28.73	4.40	5.00	52.91	0.80	0.10	0.43
395	“ “	8.22	0.87	28.58	5.49	5.81	51.03	0.93	0.19	0.93
396	“ “	8.38	0.90	28.80	5.36	5.38	51.18	0.86	0.23	1.47
411	“ “	7.57	1.26	30.21	4.66	3.44	52.86	0.55	0.28	0.96
419	“ “ (?)	21.67	1.57	23.61	4.90	4.58	43.67	0.73	0.20	1.40
420	“ “ Western (?)	9.39	1.13	27.03	4.80	4.26	53.39	0.68	0.18	0.94
427	“ “ Yellow Dent	8.14	1.40	30.31	7.07	3.63	49.45	0.58	0.40	0.80
	Average	**9.71**	**1.26**	**27.46**	**5.98**	**5.91**	**49.69**	**0.94**	**0.26**	**1.02**

HAY FROM GERMAN MILLET, LUCERN AND ORCHARD GRASS.

Station number.	BRAND.	COUNTY.	SAMPLED BY.	Date of Sampling.
343	Hungarian Millet	Middlesex	Chemist of Station	Aug. 3, '86.
352	“ Grass Hay	Warren.	Asst. Chemist of Station	Oct. 26, '86.
381	“ “ “	Cumberland	Theo. F. Baker	Nov. 12, '86.
386	German “ “	“	“ “ “	“ “ “
388	“ Millet	Salem	Omar Borton	Nov. 19, '86.
399	“ “	Ocean	John H. Irons	Nov. 26, '86.
430	“ “	Cape May	Ephraim Hildreth	Sept. 1, '86.
338	Lucern, 1st Cut	Middlesex	Chemist of Station	June 6, '86.
342	“ 2d “	“	“ “ “	July 19, '86.
347	“ 3d “	“	“ “ “	Sept. 11, '86.
370	Orchard Grass Straw	Cumberland	H. I. Budd	Nov. 18, '86.
387	“ “ Hay	Middlesex	Charles Elkins	
392	“ “ “	Salem	Sheppard Taylor	Nov. 19, '86.

CORN STALKS.

Station number.	BRAND.	COUNTY.	SAMPLED BY.	Date of Sampling.
349	Corn Stalks, Dent	Warren	Asst. Chemist of Station	Oct. 26, '86.
350	“ “ Yellow Flint	“	“ “ “ “	“ “ “
374	“ Fodder, Yellow Dent	Burlington	H. I. Budd	Nov. 18, '86.
376	“ “ Sweet	“	“ “	“ “ “
382	“ Stalks	Cumberland	Theo. F. Baker	“ “ “
395	“ “	Salem	Reeves Flitcraft	Nov. 19, '86.
396	“ “	Ocean	John H. Irons	“ “ “
411	“ “	Gloucester	Geo. B. Hurff	Nov. 22, '86.
419	“ “ Western	Middlesex	James Neilson	
420	“ “ Yellow Dent	“	“ “	
427	“ “	Cape May	Ephraim Hildreth	Nov. 22, '86.

OATS STRAW.

Station number.	Brand.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
351	Oats Straw	11.42	2.73	31.82	4.76	6.88	42.39	1.10	0.12	0.92
372	" " Barley	7.41	1.91	36.66	5.28	3.19	45.55	0.51	0.18	1.24
391	" "	7.95	1.80	40.23	4.65	3.19	42.18	0.51	0.23	1.36
408	" "	7.64	2.17	29.52	4.26	5.00	51.41	0.80	0.21	0.99
413	" "	7.64	2.28	38.44	5.05	3.88	42.71	0.62	0.49	1.86
424	" "	7.13	2.20	35.82	5.20	3.06	46.59	0.49	0.16	1.37
385	" "	7.26	1.72	41.80	4.06	3.06	42.10	0.49	0.12	0.80
	Average	**8.06**	**2.12**	**36.33**	**4.75**	**4.04**	**44.71**	**0.65**	**0.22**	**1.22**

WHEAT STRAW.

Station number.	Brand.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
364	Wheat Straw	6.78	0.85	36.70	3.33	3.00	49.34	0.48	0.06	0.87
384	" "	6.84	0.81	37.62	4.12	3.19	47.42	0.51	0.10	0.75
403	" "	7.63	1.82	34.30	3.03	3.63	49.59	0.58	0.13	0.68
410	" "	7.07	1.58	34.51	3.34	2.94	50.56	0.47	0.05	0.67
	Average	**7.08**	**1.27**	**35.78**	**3.45**	**3.19**	**49.23**	**0.51**	**0.09**	**0.74**

RYE STRAW.

Station number.	Brand.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
362	Rye Straw	6.30	1.29	41.52	3.60	2.75	44.54	0.44	0.33	0.84
363	" "	6.51	1.16	32.70	3.12	3.63	52.88	0.58	0.53	0.81
407	" "	7.15	1.15	38.32	3.31	3.19	46.88	0.51	0.37	0.51
409	" "	6.32	1.58	36.73	2.93	3.19	49.25	0.51	0.14	0.87
416	" "	6.80	1.15	39.46	3.14	2.88	46.57	0.46	0.21	1.05
417	" "	6.78	1.20	40.58	3.37	3.00	45.07	0.48	0.17	0.64
	Average	**6.64**	**1.25**	**38.22**	**3.25**	**3.11**	**47.53**	**0.50**	**0.29**	**0.79**

OATS STRAW.

Station number.	BRAND.	COUNTY.	SAMPLED BY.	Date of Sampling.
351	Oats Straw, White	Warren	Asst. Chemist of Station	Oct. 26, '86.
372	“ “ Barley	Burlington	H. I. Budd	Nov. 18, '86.
391	“ “	Salem	Geo. Kirby	Nov. 19, '86.
408	“ “	Ocean	John H. Irons	“ “ “
413	“ “	Gloucester	Geo. B. Hurff	“ “ “
424	“ “	Cape May	Ephraim Hildreth	July 15, '86.
385	“ “ Black Oats	Cumberland	Theo. F. Baker	Nov. 12, '86.

WHEAT STRAW.

Station number.	BRAND.	COUNTY.	SAMPLED BY.	Date of Sampling.
364	Wheat Straw	Burlington	H. I. Budd	Nov. 18, '86.
384	“ “	Cumberland	Theo. F. Baker	Nov. 12, '86.
403	“ “	Ocean	John H. Irons	Nov. 19, '86.
410	“ “	Salem	Elmer Duell	Nov. 27, '86.

RYE STRAW.

Station number.	BRAND.	COUNTY.	SAMPLED BY.	Date of Sampling.
362	Rye Straw	Burlington	H. I. Budd	Nov. 18, '86.
363	“ “	“	“ “	“ “ “
407	“ “	Ocean	John H. Irons	Nov. 19, '86.
409	“ “	Salem	Elmer Duell	Nov. 27, '86.
416	Rye Straw Threshed with a machine	Gloucester	Geo. B. Hurff	Nov. 22, '86.
417	Rye Straw Threshed with a flail	“	“ “ “	Nov. 23, '86.

MISCELLANEOUS SAMPLES.

Station number.	BRAND.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
345	Hungarian Grass Seed......	9.51	4.72	7.65	4.96	9.94	63.22	1.59	0.47	0.38
346	" " Straw.....	10.98	0.90	32.18	6.38	2.75	46.81	0.44	0.11	0.98
348	Sweet Potatoes.................	67.90	0.36	0.60	0.82	1.28	29.04	0.20	0.04	0.33
354	Buckwheat Straw............	9.00	0.65	37.16	6.51	7.75	38.93	1.24	0.13	1.14
355	Oil Meal, Old Process.......	7.63	9.40	7.21	5.18	38.19	32.39	6 11	1.39	0.64
356	Timothy and Clover Hay.	7.28	2.06	28.56	6.10	8.56	47.44	1.37	0.37	2.39
369	Red Clover, Alsike and Timothy....................	7.22	1.09	30.77	6.20	9.38	45.43	1.50	0.41	1.97
371	Orchard Grass and 2d Crop Clover...............	7.76	2.65	24.12	5.62	14.00	45.85	2.24	0.53	1.20
393	Hay from B'nk'd Meadows	8.49	1.78	20.46	7.85	9.29	52.13	1.49	0.50	1.54
397	Herd Grass......................	7.48	1.50	26.62	4.80	6.25	53.35	1.00	0.35	1.57
423	Black Grass Hay.............	8.20	2.18	26.55	5.60	5.44	52.03	0.87	0.11	1.57
426	Short Sedge......................	8.52	2.38	21.27	10.58	7.25	50.00	1.16	0.14	1.13
429	Marsh Rosemary..............	7.83	1.97	25.13	5.82	5.25	54.00	0.84	0.06	0.27

BOG HAY AND SALT HAY.

Station number.	BRAND.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
389	Bog Hay..........................	7.83	2.00	23.58	12 11	8.81	45.67	1.41	0 29	1.04
405	" "	8.33	2.29	26.66	4.54	6.51	51.67	1.04	0.07	0.42
	Average..................	**8.08**	**2.15**	**25.12**	**8.33**	**7.66**	**48.67**	**1.23**	**0.18**	**0.73**
378	Salt Hay..........................	8.16	2.11	25.08	7.14	5.13	52 38	0.82	0.10	0.92
422	" "	8.06	2.42	25.27	5.93	4.00	54.32	0.64	0.07	0.72
	Average..................	**8.11**	**2.26**	**25.18**	**6.53**	**4.57**	**53.35**	**0.73**	**0.09**	**0.82**

CREEK SEDGE.

Station number.	BRAND.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
418	Creek Sedge.....................	49.01	0.62	14.41	5.44	1.20	29.32	0.22	trace.	0.37
421	" "	34.60	1.53	17.88	7.77	2.70	35.52	0.43	0.06	0.70
	Average.................	**41.80**	**1.08**	**16.15**	**6.60**	**1.95**	**32.42**	**0.33**	**0.03**	**0.53**

MISCELLANEOUS SAMPLES.

Station number.	BRAND.	COUNTY.	SAMPLED BY.	Date of Sampling.
345	Hungarian Grass Seed	Middlesex	Director of Station	Sept. 9, '86.
346	" " Straw	"	" " "	" " "
348	Sweet Potatoes	Cape May	" " "	
354	Buckwheat Straw	Warren	Asst. Chemist of Station	Oct. 26, '86.
355	Oil Cake Meal		Charles Collins	Nov. 15, '86.
356	Timothy and Clover Hay	Burlington	H. I. Budd	Nov. 18, '86.
369	Red Clover, Alsike and Timothy	"	" "	" " "
371	Orchard Grass and 2d Crop Clover	"	" "	" " "
393	Banked Meadow Hay	Salem	Omar Borton	Nov. 19, '86.
397	Herd Grass	Ocean	John H. Irons	" " "
423	Black Grass Hay	Cape May	Ephraim Hildreth	Sept. 1, '86.
426	Short Sedge	" "	" "	Sept. 10, '86.
429	Rosemary	" "	" "	Sept. 1, '86.

BOG HAY AND SALT HAY.

Station number.	BRAND.	COUNTY.	SAMPLED BY.	Date of Sampling.
389	Bog Hay	Salem	Amos Peterson	Nov. 19, '86.
405	" " from Cranberry Bog	Ocean	John H. Irons	" " "
378	Salt Hay, Middle Marsh	Cumberland	Theo. F. Baker	Nov. 12, '86.
422	" " " "	Cape May	Ephraim Hildreth	Sept. 1, '86.

CREEK SEDGE.

Station number.	BRAND.	COUNTY.	SAMPLED BY.	Date of Sampling.
418	Creek Sedge	Cape May	Mr. Hand	Dec. 2, '86.
421	" "	" "	Ephraim Hildreth	Nov. 1, '86.

BRAND.	FROM THE REPORT OF	Number of Analyses.	DRY MATTER.			PROTEINE.			FAT.			NITROGEN, FREE EXTRACT.			CRUDE FIBER.			ASH.
			Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	
Clover Hay.	Professor Julius Kuhn................	......	77.10	90.00	83.30	7.20	15.80	11.00	1.20	5.50	3.20	22.30	39.70	32.90	19.50	43.00	29.90	6.30
	Dr. E. H. Jenkins, Conn. Station.	12	78.18	91.63	84.98	8.87	13.06	11.38	1.47	3.10	1.98	35.03	45.47	40.11	23.79	28.64	26.35	5.15
	New Jersey Station....................	11	91.48	93.89	92.30	10.31	14.06	12.46	1.64	2.87	2.08	39.27	49.03	42.77	23.74	35.65	28.20	6.80
Timothy Hay...	Professor Julius Kuhn................	......	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Dr. E. H. Jenkins, Conn. Station.	18	85.70	91.30	87.42	4.88	9.60	6.36	1.08	3.30	2.03	41.09	48.58	44.89	22.70	34.25	29.93	4.23
	New Jersey Station....................	10	91.33	93.88	92.88	3.75	9.19	6.25	1.52	2.32	1.83	46.02	57.09	51.69	24.55	31.28	28.73	4.32
Lucern	Professor Julius Kuhn................	......	80.80	87.50	83.80	13.1	19.7	14.40	2.30	3.80	2.50	20.00	34.80	27.90	19.30	40.00	33.00	6.00
	Dr. E. H. Jenkins, Conn. Station.	......	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	New Jersey Station....................	3	92.45	94.34	93.52	15.00	18.56	17.04	1.80	2.40	2.05	35.45	39.22	37.11	26.22	33.04	30.34	7.10
Millet..............	Professor Julius Kuhn................	......	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Dr. E. H. Jenkins, Conn. Station.	8	....	....	83.30	5.56	10.67	6.59	1.30	2.14	1.81	34.85	44.71	42.49	26.18	28.94	27.16	5.24
	New Jersey Station....................	7	90.95	93.22	92.25	5.00	12.25	7.59	1.45	2.19	1.78	44.42	52.97	49.19	23.58	30.25	27.53	6.18
Salt Marsh Hay	Professor Julius Kuhn................	......	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Dr. E. H. Jenkins, Conn. Station.	11	81.40	92.80	89.53	4.30	7.80	5.90	1.63	3.10	2.32	34.10	53.67	42.42	27.00	37.90	31.47	7.42
	New Jersey Station....................	2	91.84	91.94	91.89	4.00	5.13	4.57	2.11	2.42	2.26	52.38	54.32	53.35	25.08	25.27	25.18	6.53

BRAND.	FROM THE REPORT OF	Number of Analyses.	DRY MATTER.			PROTEINE.			FAT.			NITROGEN, FREE EXTRACT.			CRUDE FIBER.			ASH.
			Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Average.
Corn Stalks......	Professor Julius Kuhn..................	......	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Dr. E. H. Jenkins, Conn. Station.	6	60.63	77.07	67.95	3.39	4.97	4.29	0.66	1.56	1.24	30.52	40.82	35.96	18.65	25.18	22.14	4.32
	New Jersey Station.............	11	78.33	92.43	90.29	3.63	9.56	5.91	0.87	1.95	1.26	43.67	57.47	49.69	23.61	30.31	27.46	5.98
Wheat Straw....	Professor Julius Kuhn..................	......	74.00	91.90	85.70	1.40	5.60	3.10	0.60	2.00	1.20	26.70	44.40	37.50	28.90	52.60	40.00	3.90
	Dr. E. H. Jenkins, Conn. Station.	2	88.63	92.22	90.43	2.19	2.56	2.37	1.24	2.53	1.89	41.51	47.01	44.27	37.32	40.05	38.68	3.22
	New Jersey Station	4	92.37	93.16	92.92	2.94	3.63	3.19	0.81	1.82	1.27	47.42	50.56	49.23	34.30	37.62	35.78	3.45
Rye Straw.........	Professor Julius Kuhn..................	.....	81.40	89.70	85.70	1.50	4.60	3.00	1.10	2.50	1.30	23.40	44.50	33.30	30.10	54.90	44.00	4.10
	Dr. E. H. Jenkins, Conn. Station.	1	....	....	87.50	....	....	6.89	....	....	2.68	....	....	35.70	....	....	34.20	8.03
	New Jersey Station......................	6	92.85	93.70	93.36	2.75	3.63	3.11	1.15	1.58	1.25	44.54	52.88	47.53	32.70	41.52	38.22	3.25
Oats Straw.......	Professor Julius Kuhn.................	......	78.80	89.70	85.70	1.30	7.00	4.00	1.00	5.10	2.00	24.90	48.90	35.60	30.00	50.20	39.70	4.40
	Dr. E. H. Jenkins, Conn. Station.	3	87.50	93.47	89.89	2.30	5.08	3.35	1.00	3.15	2.07	26.42	44.26	36.97	35.21	55.96	42.78	4.72
	New Jersey Station.....................	7	88.58	92.87	91.94	3.06	6.88	4.04	1.72	2.73	2.12	42.10	51.41	44.71	29.52	41.80	36.33	4.75
Buckwheat Straw.	Professor Julius Kuhn..................	......	84.50	90.30	87.90	3.10	5.50	4.10	1.30	1.60	1.40	29.90	37.10	32.90	35.30	51.80	44.30	5.20
	Dr. E. H. Jenkins, Conn. Station.	2	89.50	89.60	89.55	3.33	4.38	3.85	1.42	1.70	1.56	32.08	34.49	33.28	44.93	46.83	45.88	5.05
	New Jersey Station......................	1	....	....	89.02	....	....	7.75	....	....	0.65	....	....	38.93	....	....	37.16	6.51

LUCERN, OR ALFALFA.

(*Medicago sativa.*)

Its advantages and disadvantages.
Letters relating to its growth in New Jersey, from Mr. G. W. Thompson and Dr. A. D. Newell.
Comparison between alfalfa and clover.
The period of growth at which alfalfa should be cut.

When large herds of milch cows are kept upon small farms and soiling is the farmer's chief reliance, great need is often felt of some green crop to use after fodder rye has become unfit for stock food. This sometimes occurs two or three weeks before clover is in condition to be used with profit.

Of all crops hitherto grown in this State, lucern, sometimes known as alfalfa, is one of the earliest to mature, and consequently promises most in this respect; it offers, in addition, advantages which few other plants possess; briefly, some of these are as follows:

Lucern when once well rooted withstands drought and frost in a remarkable manner.

In New Jersey it can be cut three or four times each season, for five or six years in succession, yielding, under favorable conditions, as heavy a tonnage per acre as fodder corn, which it noticeably surpasses in quality.

Testimony drawn from reliable sources in England, in the United States, and in South America, indicates that, when cut while in blossom and fed green, it is greedily eaten by working horses, and is found to be excellent food for them. Its value as hay is also very high.

It resembles clover in its preparation of the ground for following crops, for after a field has supported lucern for seven consecutive years it can then produce more grain than before.

As experiments with it were made by Chancellor Livingston in New York State ninety years ago, with very flattering results, and as agricultural journals and reports for many years past contain numerous well-written and very favorable descriptions of the plant, and further, as it is now recognized as the main dependence in many Western States, it is difficult to understand why it has not come into general use, particularly in certain sections of New Jersey which are noted for light soils with relatively open subsoils, and a water-level perhaps eight feet from the surface of the ground. The explanations for this neglect differ with localities, one most frequently heard being the difficulty of securing a good "catch." For this the remedy is deep plowing, thorough harrowing, and seeding in drills instead of broadcast. Weeds and grasses quickly outgrow and destroy young alfalfa; this renders cultivation desirable and makes seeding in drills a necessity. The advantages which follow the cultivation of this crop are put in a strong light by Jethro Tull* in his well-known book on "The Horse Hoeing Husbandry," published in London in 1829. It is well known, however, that conditions exist in certain localities which make drilling and cultivation unnecessary labor. This does not refer to harrowing in the spring, which many English farmers regard as the first step to be taken in securing a long-lived lucern field. The selection of seed from responsible sources is absolutely necessary; carelessness in this respect being doubtless the true cause of many failures.

That lucern is now successfully grown in New Jersey is demonstrated by the following extract from a letter written recently by Mr. George W. Thompson, of Stelton, Middlesex county, to the Director of this Station:

"From my three years' experience with lucern (alfalfa) as a forage crop, I am very sanguine as to its value as a component of almost any good ration for beef or butter; and just here my dairy-maid interposes her say that, 'last summer I could always tell when you had been feeding alfalfa the day before.' This we might infer from its analysis, rating higher in albuminoids than most if not all of our forage plants.

"For soiling with intensive farming, I am of the opinion it may be made a decided success. It may be cut two or three weeks before clover is usually ready, and when green rye (if desirable at all) is not usually relished by cattle. The second crop will be in good time to make a good and easily-cured hay, while the third cutting will be much better than the usual second-crop clover under similar circumstances.

"This is my faith now about the work. If spared, I intend to plant an additional acre, at least, the coming spring.

"The soil is a light, not sandy, loam. In potatoes last season. I shall apply fifteen loads, on a Kemp spreader, of good manure (not straw and cornstalks) to the acre, plow, subsoil and manipulate the ground, so as to get it in a good state of tilth, applying, near the surface, two or three hundred pounds of acid phosphate, with about as much muriate of potash, or its equivalent in kainit, relying on my stable manure for all the nitrogen I want. I will sow after the middle of April, as soon as the ground will suit. I expect, with an ordinary season, to cut two good crops from the seed sown this spring.

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*Jethro Tull was born in 1680 and died in 1740; his book was first published in 1731. The above reference was taken from Corbett's edition, published in 1829.

"From my present experience, twenty pounds of seed is not enough to produce a maximum crop.

"I am not so sure that, for ordinary farm use, it will take the place of clover in this part of New Jersey. The first crop matures before we have good haying weather, generally, but for soiling or silage, I am of opinion we have in lucern a better and cheaper crop than corn fodder. I have not been successful in raising seed."

A letter from Dr. A. D. Newell, of New Brunswick, also contains matter of interest.

"NEW BRUNSWICK, Mar. 3d, '87.

"*Prof. Geo. H. Cook:*

"DEAR SIR—A few years ago I sowed four acres of alfalfa. It came up in twelve days and grew rapidly. I think I sowed it after oats and cut it once that season. There was a drouth for some time after seeding, and the catch was not even, so I plowed it in, after cutting it three times the second season. I found the roots long and branching.

"Mr. Joseph Corbit, just back of the Hoffman farm, has an acre or so on shale; has cut it three times a season for the last two seasons. He feeds it green, and the cattle do well on it. He is very much pleased with it, and intends to sow more this season. It does not heave out like clover, as the roots take such firm hold.

"Respectfully yours,

"A. D. NEWELL."

Mr. Thompson allowed the chemists of this Station to stake off a square rod in his alfalfa field, and also afforded them every opportunity for cutting, weighing and sampling the first, second and third crops from this area. He also fixed the dates upon which to cut the crop, in order to secure the most favorable results, paying due regard both to the quantity and quality of the product.

For the sake of comparison with lucern, a square rod of unusually fine clover was staked off upon the farm of Professor Geo. H. Cook, near New Brunswick. The first and second crops were cut from this plot in each case, when this clover was at its best, in the opinion of practical farmers.

The chemical analysis of samples of both products, secured from the above cuttings, gave the following results:

Station number.	Brand.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
338	Lucern, 1st Cut, June 4th, '86..	79.43	0.54	5.84	1.92	4.13	8.14	0.66	0.10	0.58
342	" 2d " July 19th, '86..	73.80	0.49	9.08	1.78	4.82	10.03	0.77	0.12	0.54
347	" 3d " Sep. 11th, '86..	70.00	0.63	10.02	1.98	4.79	12.58	0.77	0.11	0.55
	Average......................	**74.41**	**0.55**	**8.31**	**1.89**	**4.58**	**10.25**	**0.73**	**0.11**	**0.56**
341	Clover, 1st Cut, July 30th, '86..	73.48	0.67	8.38	2.08	3.66	11.73	0.59	0.12	0.85
344	" 2d " Aug. 26th, '86..	68.89	0.96	8.66	2.79	4.63	14.07	0.74	0.12	0.98
	Average......................	**71.19**	**0.81**	**8.52**	**2.43**	**4.15**	**12.90**	**0.67**	**0.12**	**0.92**

This table indicates no very noticeable differences, in chemical composition, between clover and lucern. A second table is needed to show their relative yields of food per acre:

Lucern.	Tons per Acre.	CONTAINING POUNDS PER ACRE OF				
		Fat.	Fiber.	Ash.	Proteine.	Carbohydrates.
First Cut, June 4th..................................	8.25	89.0	978.4	316.4	680.6	1,341.5
Second Cut, July 19th.............................	6.16	60.4	1,118.7	219.3	593.8	1,235.7
Third Cut, Sept. 11th.............................	3.76	47.4	753.5	148.9	360.2	946.0
Total...	18.17	196.8	2,850.6	684.6	1,634.6	3,523.2
Clover.						
First Cut, July 30th, '86..........................	10.88	152.3	1,823.5	452.6	796.4	2,552.4
Second Cut, Aug. 26th, '86......................	4.16	79.9	720.5	232.1	385.2	1,170.6
Total...	15.04	232.2	2,544.0	684.7	1,181.6	3,723.0

Three cuttings of lucern yielded 18.2 tons, and two cuttings of clover yielded 15 tons per acre of green fodder, which was weighed, in each case, before any loss of moisture had occurred.

The production per acre, by each crop of carbohydrates, including fiber, was practically identical, the difference, amounting to less than two per cent., being in favor of the lucern.

The clover excelled by seventeen per cent. in the production of crude fat, but the lucern excelled by nearly forty per cent. in the production of crude proteine.

In their demands upon the soil, these crops were absolutely identical as regards quantity, for each contained 685 pounds of ash per acre. The following table will give an idea of the chemical composition of this ash, and, at the same time, indicate the requirements of these plants.

The Quantities of Nitrogen, Phosphoric Acid, and Potash per Acre, Removed Annually by Lucern and Clover.

BRAND.	Pounds of Nitrogen.	Pounds of Phosphoric Acid.	Pounds of Potash.
Lucern, 1st Crop	108.8	16.5	95.6
“ 2d “	94.9	14.8	66.5
“ 3d “	57.9	8.3	41.4
Total	**261.6**	**39.6**	**203.5**
Clover, 1st Crop	128.4	26.1	185.0
“ 2d “	61.6	10.0	81.5
Total	**190.0**	**36.1**	**266.5**
20 tons of excellent Yard Manure	204.0	164.0	200.0

In their demands for phosphoric acid, clover and lucern agree very closely, but lucern, apparently, can develop its crop with approximately 25 per cent. less potash than clover utilizes.

The demands for plant-food seem enormous, however, in both cases, and may be expressed as follows: The plant-food in the crop from one acre of Mr. Thompson's alfalfa represents the following weights and values of fertilizers:

Nitrate of Soda,	1,625 pounds, worth		$40 63
Acid Phosphate,	300 “	“	2 25
Muriate of Potash,	410 “	“	8 20
			$51 08

The plant-food in Dr. Cook's clover, in like manner, represents per acre:

Nitrate of Soda,	1,190 pounds, worth		$29 75
Acid Phosphate,	300 “	“	2 25
Muriate of Potash,	530 “	“	10 60
			$42 60

Twenty tons per acre of excellent barn-yard manure is shown by the table to contain a quantity of phosphoric acid several times in excess of the demands of either clover or lucern. The manure also contains potash enough to meet the wants of the alfalfa, but requires an addition of 400 pounds of nitrate of soda to increase its nitrogen to the amount present in this crop. The clover, on the other hand, could take its supply of nitrogen entirely from the manure, but would need an additional supply of potash, equivalent to 125 pounds of muriate. The question may arise as to the source of the plant-food necessary to support this crop upon the same fields for five consecutive years.

The light, sandy soils of Rio Grande, in Cape May county, weigh, approximately, 100 pounds per cubic foot. Calculated upon a depth of nine inches, each acre contains 32,670 cubic feet, which weigh 3,267,000 pounds. A series of analyses of these soils was made under the direction of Dr. Peter Collier, and published by the United States Department of Agriculture. The highest and lowest percentages of plant-food found were as follows:

	Phosphoric Acid. Per cent.	Potash. Per cent.	Nitrogen. Per cent.
Maximum..............	0.088	0.238	0.128
Minimum..............	0.024	0.061	0.045

These percentages, calculated upon the total weight of soil per acre, give the following as the absolute amounts of plant-food present:

	Phosphoric Acid. Per acre.	Potash. Per acre.	Nitrogen. Per acre.
Maximum..............	2,875 ℔s.	7,775 ℔s.	4,182 ℔s.
Minimum	784 “	1,993 “	1,470 “

The first nine inches of the poorest soil contains enough potash to support alfalfa for ten years, and enough phosphoric acid to support it twenty years. In these respects the best soil would support the crop four times as long. Nitrogen appears to be deficient in one case and abundant in the other.

The following statement from the Report of the Commissioner of Agriculture for 1873 indicates, however, that alfalfa, in securing its food, is not limited to surface soils:

> "The freshet of last winter cut away the bank of a creek, exposing a section of an alfalfa field. The roots of the plant had penetrated to a depth of from 12 to 20 feet, and were exposed, by the washing away of the bank, from the surface to the water-line. The diameter of the root at the crown, on the surface, varies from an eighth to half an inch. They taper gradually to the lower end, from which a cluster of roots or feeders put out. In the section exposed, the roots were close together, but entirely disconnected, each one growing straight through the soil to the water, and producing on the surface a luxuriant branch of alfalfa, which keeps green the year round."

If the alfalfa is fed to live stock upon the farm, it must be regarded as an extremely valuable agent for bringing into circulation the capital invested in the subsoil. If it is raised for market, however, it should be remembered that a crop as heavy as Mr. Thompson's contains plant-food which would cost, in the shape of fertilizers, more than fifty dollars per acre, a fact which should be distinctly seen both in the purchase and sale of this product.

At what Period in its Growth should Lucern be Cut in Order to Yield the Largest Amounts of Food per Acre.

This question was carefully studied, in 1873, by the German investigator, Dr. Paul Wagner.

Two plots, each containing two square rods, were staked off in an alfalfa field. The crop from one was cut three times, each time just before the blossoms appeared. That from the other plot was cut twice only, after most of the plants were in full bloom.

The results can be seen from the following table:

Plots.	Tons per Acre.	CONTAINING POUNDS OF				
		Fat.	Fiber.	Ash.	Proteine.	Carbohydrates.
Plot A. 1st Cut, May 31st	9.4	130.1	1,287.0	393.2	912.3	1,581.6
2d " June 8th	5.5	62.9	830.8	283.1	527.7	826.6
3d " September 1st	2.4	40.0	351.8	160.2	277.4	457.6
Total	17.3	233.0	2,469.6	836.5	1,717.4	2,865.8
Plot B. 1st Cut, June 30th	11.6	148.7	2,260.8	511.9	1,023.9	2,346.6
2d " August 20th	10.5	134.4	2,007.7	612.0	889.5	2,076.4
Total	22.1	283.1	4,268.5	1,123.9	1,913.4	4,423.0

Two crops cut while the plants were in blossom yielded more food than three crops taken each before the blossom appeared.

It is noticeable, however, that while the more mature plant excelled in its yield of fat by twenty-one per cent., and of proteine by seventeen per cent., its principal gain was due to an increase in carbohydrates and crude fiber, the former by fifty-four per cent. and the latter by seventy-three per cent. Dr. Wagner calls attention to the large quantity of fiber in the older plants, but feels that its digestibility is not materially reduced thereby, and concludes *that lucern, like clover, should be cut almost immediately after the blossoms have appeared.*

HUNGARIAN GRASS, OR GERMAN MILLET.

(*Panicum Germanicum.*)

Hungarian grass or German millet is a well-known forage crop about which a great deal has been written during the past twenty years. Its value depends largely upon the fact that its seed may be sown early in June, after a correct opinion has been formed regarding the coming clover crop. Approximately two months later the millet will be fit either for soiling or hay making, leaving ample time, therefore, for clearing the land and preparing it for wheat. Under ordinary conditions satisfactory yields per acre are easily secured, and when the grass is properly treated very valuable hay can be made from it, although under certain conditions it is regarded as difficult to cure.

The most serious criticism against it is that it exhausts the ground. Several progressive farmers are known who have tried the plant and have been pleased with its products, but they decline to try it again because of its injurious effects upon following crops. This criticism is, however, by no means universal, as the following abstract from a letter recently received from Mr. Adrian Vermeule, New Brunswick, Middlesex county, will indicate:

> "This millet, when cut at the proper time, makes excellent hay for cattle, better than timothy and very nearly equal to clover mixed. It yields well, and for a crop preceding wheat, I think, leaves the land in better condition than oats. The past season I left two and one-half acres for seed. The yield was twenty bushels per acre; when left for the seed to ripen the hay is woody, and, in my opinion, not superior to oat straw. After harvesting the millet, the field was manured, limed and fertilized alike throughout, and sowed with wheat. Where the millet had been cut for hay the wheat looks better than it does where it was left for seed."

In 1886 Mr. Vermeule substituted millet for oats on seven acres of his farm. He allowed the Station's chemist to measure off a definite area in this field, from which the crop was cut and weighed on the second of August; the seeds then were formed but were still very soft; all samples necessary for a chemical examination of the hay were also secured on this date. One month later a measured area was also staked off from a portion of one field which had been reserved for seed. The crop from this plot was dried, threshed in due season, and the weights of its products accurately determined. The returns indicated thirty-three bushels of seed and two tons of straw per acre. Both seed and straw have been analyzed; the results are published in the preceding table on fodders, indicated by Station numbers 345 and 346.

The leading object of this work on millet was to secure information relative to its exhaustion of the soil.

The plan was to compare it with mixed clover and timothy in order to learn—

I. The relative amount of animal food produced by each crop.

II. The amounts of plant-food extracted by each from the ground.

The sample of mixed clover and timothy was taken from an experimental plot on the College Farm, upon which barn-yard manure had been used for three consecutive years, each year at the rate of twenty tons per acre.

The experimental plot of millet on Mr. Vermeule's farm was located upon the edge of a former compost heap, and was characterized by an unusually heavy and rank growth.

I.

THE RELATIVE AMOUNTS OF ANIMAL FOOD PRODUCED IN CROPS OF MIXED HAY AND GERMAN MILLET.

The percentage composition of each product can be seen from the following table:

Station number.	Brand.	POUNDS PER HUNDRED OF						PERCENTAGE OF		
		Water.	Crude Fat.	Crude Fiber.	Ash.	Crude Proteine.	Carbohydrates.	Nitrogen.	Phosphoric Acid.	Potash.
343	Hay from Hungarian Grass	7.10	1.83	30.25	6.70	6.19	47.93	0.99	0.33	1.31
431	Mixed Clover and Timothy Hay	6.57	1.92	28.95	4.77	4.69	53.10	0.75	0.33	1.74

As a rule, these analyses indicate slight differences only in the quality of these fodders; one of the most valuable ingredients, the proteine, forms, however, a striking exception. This becomes, of course, more marked when the calculations are expressed as pound of animal food per ton of hay.

Brand.	ONE TON OF HAY CONTAINS FOLLOWING WEIGHTS OF ANIMAL FOOD.				
	Fat.	Fiber.	Ash.	Proteine.	Carbohydrates.
	lbs.	lbs.	lbs.	lbs.	lbs.
Hay from Hungarian Grass	36.6	605.0	134.0	123.8	958.6
Mixed Clover and Timothy Hay	38.4	579.0	95.4	93.8	1,062.0

In carbhydrates the mixed hay excels by more than *ten* per cent.; in proteine, however, the millet excels by *thirty-three per cent.* These calculations are of especial importance to those who purchase and sell hay by the ton. Farmers, however, must be governed by the relative yields per acre, at least, until the feeding value of a crop has a more positive influence upon its market price.

BRAND.	Tons per Acre.	CONTAINING POUNDS PER ACRE OF				
		Fat.	Fiber.	Ash.	Proteine.	Carbohydrates.
Hay from Hungarian Grass	2.6	95.2	1,573.0	348.4	321.9	2,492.4
Mixed Clover and Timothy Hay	3.6	138.2	2,084.4	343.4	337.7	3,823.2

The farms upon which these crops were grown are approximately two miles apart, both are credited with red shale soils and both have been farmed in the same general manner. Each farmer regarded his crop as thoroughly satisfactory, and probably three and six-tenths tons of mixed hay and two and six-tenths tons of dried millet per acre may be regarded as representative yields of each. On this assumption, an acre in mixed hay yields as much proteine as one in millet, but in carbhydrates and fiber, the mixed hay excels by more than forty-five per cent.

Regarded from the producers' standpoint, the mixed clover and timothy is the more profitable crop, and Hungarian grass must be regarded as a supplementary plant which may be sown after it is evident that a poor catch or severe winter has made an average hay yield impossible.

II.

THE AMOUNTS OF PLANT–FOOD EXTRACTED FROM THE SOIL BY CROPS OF MIXED HAY AND GERMAN MILLET.

The analysis printed upon a preceding page gives the percentages of nitrogen, phosphoric acid and potash, both in mixed hay and dried millet. These have been recalculated into absolute weights per ton of hay with the following results. For comparison, the number of pounds of each of these three elements of plant-food to be found in a ton of clover or lucern has also been added :

BRAND.	Pounds of Nitrogen in one ton of hay.	Pounds of Phosphoric Acid in one ton of hay.	Pounds of Potash in one ton of hay.
Hay from Hungarian Grass	19.8	6.6	26.2
Timothy Hay and Clover	15.0	6.6	34.8
Clover, Average of Two Cuts	43.8	7.6	59.6
Lucern, " " Three "	54.6	8.0	42.0

With a single exception, millet requires less expensive plant-food than either of the other products mentioned in this table. This exception is found in the case of nitrogen in mixed hay.

When these results are calculated upon the crop returns per acre, the results are still more favorable for the millet, as the following table shows:

BRAND.	Pounds of Nitrogen taken from an acre by a crop of—	Pounds of Phosphoric Acid taken from an acre by a crop of—	Pounds of Potash taken from an acre by a crop of—
Hay from Hungarian Grass	51.5	17.1	68.1
Timothy Hay and Clover	54.0	23.7	125.3
Clover "	190.0	36.1	266.5
Lucern	261.6	39.6	203.5

A crop of mixed clover and timothy takes from an acre of ground more nitrogen, more phosphoric acid and more potash by fifty per cent. than a crop of millet.

A crop of clover extracts four times as much nitrogen and potash and twice as much phosphoric acid from an acre as a crop of millet.

Lucern, in some respects, uses even more plant-food than clover.

A more definite opinion of the relative amounts of expensive plant-food removed from the soil by the above-mentioned crops can be gained by computing the cost of returning to the soil equivalent amounts of equally available plant-food, used in the form of commercial fertilizers.

The estimates are as follows:

Brand.	Nitrate of Soda.		Acid Phosphate.		Muriate of Potash.		
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
Hungarian Grass and Hay	320	$8 00	130	$0 98	175	$3 50	$12 48
Timothy Hay and Clover	335	8 38	180	1 35	250	5 00	14 73
Clover Hay	1,190	29 75	300	2 25	530	10 60	42 60
Lucern "	1,625	40 63	300	2 25	410	8 20	51 08

The lightest demands are made by Hungarian grass, for the cost of returning all of the expensive food removed by it from an acre of soil is $12.48 only; still the Hungarian grass is considered an exhaustive crop. The heaviest demands are made by clover and lucern. A good clover crop, for instance, takes $42.60 worth of expensive plant-food from an acre, and $51 is needed to replace that extracted by an acre of lucern, yet both of these crops leave the surface-soil noticeably enriched by their growth.

The question, therefore, depends upon the location in the ground from which each crop extracts its food.

Clover and lucern are well-known deep feeders; timothy roots have also been followed two or three feet below the surface, but millet, on the other hand, is said to feed entirely in the first three or four inches of soil. Admitting the truth of these statements, and the differences between these crops consists solely in the fact that one class drains the subsoil, and its effects are noticed only after years of cultivation; the millet drains the surface-soil and its effects are at once apparent.

All are valuable servants to the farmer when their habits of growth are understood.

PEACH TREES AND PEACHES.

SPECIAL REPORT BY J. M. WHITE.

I have to report as follows regarding investigations concerning peach yellows and the treatment of the trees in New Jersey.

Messrs. Culver & Blew, of South River, Middlesex county, have 4,000 trees, 1,600 of which are 13 years old, on a sandy, gravelly loam with clay subsoil and rolling surface. They have fertilized mostly with bone and lime. Their practice is to sow buckwheat in their orchards the first 2 years, and afterwards to cultivate without any crop, plowing very shallow twice in the season. Their orchards have produced fine fruit, been fairly remunerative, and the majority of the trees are now in very good condition.

William Redmond, of Jamesburg, has 10,000 trees, from 2 to 15 years old, 4,000 being of the latter age, and are looking healthy and promise a good crop for the coming season. Peaches from these old trees took the first premium at the Monmouth county fair, last season. Mr. Redmond fertilizes with yard manure and all the ashes he can procure, and practices thorough cultivation, believing good cultivation equal to manure. He carefully selects his buds from healthy trees, in order to secure healthy stock to commence with, which he considers of the utmost importance. His soil varies, some being sandy and gravelly and some clay loam, but all well drained and rolling with a clay subsoil.

David S. Wyckoff, of Freehold, Monmouth county, has 800 trees, 12 years old, and 1,200, 4 years old, on a sandy loam with good drainage and clay subsoil. From the 12-year old trees, the past season, were received 2,000 baskets of fruit, which sold for $980 net. He fertilizes with stable manure, and practices thorough cultivation. His older trees are looking fairly well, and the younger ones are very thrifty.

Dennis Callaghan, of Freehold, has 1,200 trees, 4 to 5 years old, on light, sandy soil with sand subsoil. He has used Mapes' fruit and vine manure one season with good effect, obtaining some good fruit. His trees do not look well, and many are dying out.

George H. Schank, of Freehold, has 1,000 trees, 9 to 10 years old, on land which had been lately cleared, the soil being a sandy loam with gravel bottom and a rolling surface. He fertilizes mostly with lime and marl. His cultivation is good and his trees are looking healthy, but very much more vigorous upon a portion of the ground which has formerly been used in growing sweet potatoes.

E. B. Hender, of Vineland, has 800 trees, 13 years old, on gently sloping ground, with a sandy, gravelly soil with clay subsoil. This ground had been in cultivation but a few years before the orchard was planted, and formerly was occupied by a growth of pine and oak wood, and was cropped after clearing for a few years with corn and potatoes. For 2 years the orchard was occupied with hard crops, and afterwards has had thorough cultivation, the cultivation being commenced early in spring and continued through the season. The trees are kept free from borers, are treated with potash and bone, and give paying crops of fruit and are looking well.

J. C. Wheeler, of South Vineland, has 500 trees, 5 years old, and 300, 8 years old, on sandy soil with clay subsoil and rolling surface. He keeps the trees free from borers, cultivates well through the season till picking time, fertilizes with equal parts of kainit, muriate of potash, bone and sulphate of soda, and acid rock, with good results, and his trees are looking well.

E. F. Sharp, of Bridgeton, has been growing peaches successfully for 25 years, and has now 800 bearing trees, 6 years old, on a sandy, gravelly loam with clay subsoil and rolling surface. He plants his trees upon clover sod or on ground which has been in corn 1 season, and crops the orchard 2 years with corn, using stable manure for a fertilizer. After the first year he uses 200 pounds bone and 200 pounds muriate of potash per acre, giving thorough cultivation and keeping free from borers. He has sold from these 800 trees, since coming into bearing, 4,200 baskets of fruit, for $2,184 net, 2,100 baskets of which were sold in 1885, at 57 cents per basket. The trees are now looking well.

Robert Ware, of Bridgeton, has 1,000 bearing trees, 4 years old, on clay loam with clay subsoil and rolling surface. From these, in

1886, he sold 1,200 baskets of fruit, at an average price of 52 cents per basket. He practices clean cultivation and keeps out all borers. He has just taken out 1,000 trees, 10 years old, from which he had received 6 crops of good fruit. He plants corn in his orchards the first year and melons the second, fertilizing with stable manure, afterwards using kainit, ashes and bone.

Isaac M. Smalley, of Roadstown, has 3,500 bearing trees, 2 to 7 years old, on sandy loam with clay subsoil and rolling surface. He sets his trees on corn ground, and crops among his trees with corn for the first 2 years, practicing clean cultivation, and removes all borers whenever they appear. He fertilizes with kainit and bone, using 300 pounds of each per acre, applied in early spring, and has no yellows. In 1873 he sold from 4 acres, 1,800 baskets of fruit, for $1,800 dollars. In 1882 he sold from 10 acres, 3,650 baskets of fruit, for $3,650, and in 1884, sold 1,200 baskets of fruit, from 500 trees, for $672. In 1876 he took out an orchard which had given paying crops till 21 years old. He has been using kainit and bone for 5 years, with satisfactory results.

Charles Bidders, of Greenwich, has 840 trees, 4 years old, on sandy loam with clay bottom, from which he received 100 baskets of fruit the past season. On this orchard he is using annually 300 pounds kainit, 300 pounds bone and 200 pounds muriate potash per acre. He plants his trees on corn ground and cultivates corn in the orchard 2 years, fertilizing the corn with stable manure. He has just taken out an orchard of 1,400 trees, 11 to 14 years old, and which died from overbearing. At 3 years old, he used a phosphate and received from it 900 baskets of fruit; at 4 years old, 2,000 baskets sold for $2,100; at 5 years old, used kainit and sold 3,200 baskets for $1,600; at 6 years old, had only a light crop; at 7 years old, used kainit and sold 1,500 baskets for $755; at 8 years old, 1,100 baskets for $600; at 9 years old, light crop, and at 10 years old, 500 baskets.

Charles Miller, of Greenwich, has 1,100 trees, 9 years old, on sandy loam with clay bottom and sloping surface. For 3 years he has used kainit at the rate of 500 pounds to 700 pounds, and bone at the rate of 300 pounds to 500 pounds per acre, but this orchard, though the trees are large, seems to be declining. From it, in 1884, there was sold $1,300 worth of fruit; in 1885, $800, and in 1886, $300. There are upon his farm 50 trees 20 years old, which bore a heavy crop the past season. I could learn but little of the former treatment of these old trees, as the present occupant of the farm has been there but 3 years.

T. E. Hunt, of Greenwich, has 1,100 trees, 6 years old, on clay loam with clay subsoil and rolling surface. Corn planted on clover sod occupied the ground the season before the trees were put out. Mr. Hunt considers it of great importance to set out perfectly healthy trees, and also to keep the orchard well cultivated and clear of borers. He cultivates till into July, plowing only once and then doing the work with a wheel or Acme harrow. He fertilizes with muriate of potash and bone, using 200 pounds of potash and 300 pounds of bone to the acre. Since this orchard has been planted it has produced three crops, which have been sold for $4,008.05 net, the last crop, in 1886, realizing $2,080.54. This orchard occupies about 10 acres of land, and the majority of the trees are looking well. Mr. Hunt is now taking out an orchard of 200 to 300 trees, which are 20 years old, and have been remunerative. It has been fertilized with lime, marl, potash and bone, and has received good cultivation.

Dr. Henry Race, of Pittstown, Hunterdon county, who has used potash salt and bone for the past six years, writes: "In my experience, if trees bear an excessively large crop they are liable to an unhealthy appearance; the leaves turn yellow; small, reddish shoots start up from the large branches near the trunk, and the wood soon becomes of a dark, brownish color. Whether these symptoms represent the specific disease called the 'yellows,' or not, muriate of potash and superphosphate of lime, applied as soon as the crop is gathered, in the quantity of 400 or 500 pounds to the acre, with good cultivation and pruning, will prevent this premature decay, or arrest it if just commenced. If the fertilizer is withheld till the wood has become dark brown, its application may improve the appearance of the tree, but it will never become healthy and vigorous again."

From the experience and practice of the most successful peach growers, we arrive at the following conclusions, viz.: That for successful peach culture the soil must be adapted to the development of the tree and fruit, properly located and drained. Then acting upon the principle that it is better to prevent than cure disease, perfectly healthy trees should be selected for planting, and after being planted they should be thoroughly cultivated, judiciously pruned and well nourished with the proper amount of food best suited to their healthy growth and productiveness.

NITROGEN.

THE EXAMINATION AND COMPARISON OF ANALYTICAL METHODS FOR THE DETERMINATION OF NITROGEN.

The Kjeldahl method for the determination of nitrogen in fertilizers, free from nitrates, was introduced into the Station laboratory during the season of 1885.

The re-agents and apparatus used were, with slight modifications, the same as described in a review of the method published in Chem. Zeitg. VIII., 432.

The difficulties encountered then were—first, the inability, in all cases, to secure complete oxidation in a reasonable time, and, second, the serious bumping of the solution on boiling with caustic potash or soda.

The past season certain changes in the method of oxidation, noted by other chemists, were observed.

The method as now used is practically identical with that published in the Proceedings of the Third Annual Convention of the Association of Agricultural Chemists, pages 53–4–5.

No difficulty was experienced in oxidizing the most refractory substance in from one to three hours; when care was taken to continue the digestion until a perfectly colorless solution was obtained, the addition of potassium permanganate did not appear necessary; its absence also seemed to lessen the liability of the solution to bump. When caustic soda was used the boiling was perfectly smooth; with caustic potash, however, the bumping of the solution is so serious as to make it difficult to finish the determination.

It is absolutely necessary to thoroughly test all re-agents used, since sulphuric acid and caustic soda oftentimes contain traces of ammonia or nitrates. Throughout the year, in all cases where the soda-lime method was applicable, duplicate determinations by Kjeldahl's process were carried out. A comparison of the results warrants the following conclusions:

The average determinations of one hundred and twenty samples of complete fertilizers show that the higher percentages of nitrogen were secured by the Kjeldahl process; the average difference for the whole number of samples between the results from these two methods is five hundredths of one per cent.

Of the twenty-five samples of high grade organic nitrogenous material analyzed, the average percentage of nitrogen is identical by both methods.

In ground bones, dissolved bones and miscellaneous materials, the average determinations of twenty-seven samples by Kjeldahl's method were seven hundredths of one per cent. lower than by soda-lime process.

The Kjeldahl method secured slightly higher percentages of nitrogen in coarse fodder samples.

A comparison of the determinations made are tabulated below.

Station number.	BRAND.	Per cent. of Nitrogen, Soda-Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
1250	Rose Bone Fertilizer	0.31	0.32	1250
1251	Selected Esmeralda	3.85	3.88	1251
1255	Doughten's Ammoniated Superphos	2.95	2.97	1255
1257	" Potato Manure	3.10	3.14	1257
1260	Planet Phosphate	1.38	1.48	1260
1266	Bowker's Hill and Drill Phosphate	2.31	2.32	1266
1268	Star Bone Phosphate	1.99	2.00	1268
1272	Stearn's Eagle Brand	1.40	1.48	1272
1274	Bradley's Superphosphate of Lime	3.10	2.98	1274
1278	Yarnell's Ammoniated Phosphate	1.01	1.12	1278
1279	" Fish	1.54	1.52	1279

Station number.	Brand.	Per cent. of Nitrogen, Soda-Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
1281	Yarnell's High Grade Potato Manure	2.78	2.90	1281
1282	" Bone	2.57	2.59	1282
1283	W. & C. Superphosphate	1.97	1.87	1283
1286	National Complete Fertilizer	1.09	1.17	1286
1287	" Potato Fertilizer	1.47	1.54	1287
1288	" Tobacco "	1.22	1.32	1288
1293	Moro Phillips' Superphosphate	1.82	1.92	1293
1294	" " Phuine	2.25	2.22	1294
1301	Clark's Cove Unicorn	2.40	2.39	1301
1311	Lister's Potato Manure	4.72	4.82	1311
1312	Coe's High Grade Ammoniated Bone	2.06	2.18	1312
1315	" Red Brand Potato Manure	3.57	3.68	1315
1318	Ralston's Knickerbocker	2.12	2.22	1318
1319	" Ammoniated Bone Phosphate	1.82	1.89	1319
1320	" Potato Fertilizer	1.69	1.78	1320
1332	Taylor's Complete Fertilizer	2.93	2.96	1332
1339	Gaskill's Special Fish	2.12	2.06	1339
1341	Virginius Guano	3.83	3.81	1341
1342	Taylor's Complete Fertilizer, all crops	2.85	2.94	1342
1345	National Superphosphate	1.16	1.10	1345
1346	Bowker Fish and Potash	2.29	2.37	1346
1353	Allen's Complete Phosphate	1.72	1.76	1353
1354	" Special Fertilizer	1.69	1.73	1354
1355	" Potato and Truck Manure	3.40	3.51	1355

Station number.	Brand.	Per cent. of Nitrogen, Soda-Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
1357	Coe's Alkaline Bone	1.39	1.45	1357
1358	Baker's Complete Potato Manure	3.89	3.98	1358
1359	Taylor's Ammoniated Dissolved Bone and Potash	1.78	1.88	1359
1360	" Complete Fertilizer for Corn and Truck	2.44	2.38	1360
1364	Smith's Standard Grain and Grass Phosphate	2.89	3.03	1364
1367	Coe's Peach Tree Manure	1.57	1.59	1367
1368	Acme Fertilizer	4.44	4.62	1368
1370	Baker's Special Oat Manure	4.55	4.45	1370
1371	Formula A, Great Planet	4.81	4.83	1371
1373	Smith's Potato and Truck Fertilizer	3.10	3.17	1373
1376	Walton & Whann's Plow Brand	2.36	2.47	1376
1379	Queen City Phosphate	1.86	1.92	1379
1381	Baker's Fruit Tree Manure	1.80	1.92	1381
1385	Arlington B. for all Crops	2.08	2.18	1385
1388	Alpha Soluble Bone and Potash	0.07	0.16	1388
1392	Potato Manure	3.02	2.99	1392
1394	Cooke's Blood Guano	2.65	2.62	1394
1397	Dissolved Bone	1.57	1.64	1397
1398	Chittenden's Universal Phosphate	2.68	2.70	1398
1400	10 Per Cent. Guano	8.83	8.88	1400
1401	Preston's Potato Fertilizer	3.40	3.50	1401
1404	Baker's Onion Manure	4.19	4.28	1404
1405	" Strawberry Manure	2.66	2.77	1405
1409	Granger Fertilizer	2.06	2.06	1409

Station number.	BRAND.	Per cent. of Nitrogen, Soda-Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
1410	Stockbridge Potato Manure	3.29	3.38	1410
1412	Acidulated Fish Guano	1.72	1.76	1412
1415	Bone Phosphate	1.31	1.39	1415
1421	Gaskill's High Grade Manure	2.89	2.99	1421
1423	Ammoniated Bone Superphosphate	2.78	2.90	1423
1425	Potato Fertilizer	2.82	2.88	1425
1433	Bowker's Ammoniated Bone Phosphate	1.01	1.08	1433
1434	Soluble Pacific Guano	2.40	2 46	1434
1436	Gaskill's Popular Phosphate	2.03	2.15	1436
1440	Mitchell's Complete Manure	2.16	2.23	1440
1441	Potato Fertilizer	3.57	3.60	1441
1443	Coe's XXV. Phosphate	1.35	1.41	1443
1447	Swift Sure $23 Phosphate	1.39	1.45	1447
1448	Bowker's Ammoniated Superphosphate	1.12	1.24	1448
1451	Cereal Fertilizer	1.31	1.38	1451
1452	Lister's Success	1.73	1.80	1452
1458	" Ammoniated Dissolved Bone	2 31	2.39	1458
1459	" U. S. Superphosphate	1.48	1.59	1459
1462	Royal Bone	1.50	1.52	1462
1466	Ammoniated Dissolved Bone with Potash	1.12	1.22	1466
1472	A. A. Ammoniated Superphosphate	3.40	3.39	1472
1473	Pelican Bone Fertilizer	1.59	1.64	1473
1477	Lofland's Button Bone Fertilizer	1.63	1.66	1477
1479	Sardy's Phospho Peruvian Guano	2.53	2.52	1479

Station number.	BRAND.	Per cent. of Nitrogen, Soda-Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
1482	Soluble Tampico Guano	2.12	2.17	1482
1484	Ammoniated Bone Superphosphate	2.84	2.96	1484
1493	Raw Bone Superphosphate	0.94	1.08	1493
1497	Bay Side Fertilizer	1.69	1.76	1497
1499	Potato Compound	2.98	3 10	1499
1502	Prime Esmeralda Guano	1.52	1.58	1502
1505	Clark's Cove King Philip	1.50	1.57	1505
1507	Baker's Corn Manure	4 62	4.73	1507
1509	Ocean Guano	2.08	2.08	1509
1510	Allen's Nitro Phosphate	1.99	2.02	1510
1511	" Marine Guano	4.02	4.08	1511
1512	" Popular Phosphate	0.67	0.80	1512
1516	Bone Phosphate, No. I	1.03	1.12	1516
1521	Chittenden's Ammoniated Bone Superphos	2.53	2.48	1521
1522	" Complete Fertilizer	4.26	4.33	1522
1523	Buffalo Ammoniated Bone Superphosphate	3.68	3.75	1523
1524	Wheat, Corn and Oats Fertilizer	1.82	1.87	1524
1526	Clark's Cove Bay State	3.00	3.05	1526
1530	Lister Bros.' Corn Manure	4.26	4.28	1530
1532	" " Superphosphate of Lime	2.54	2.57	1532
1534	Depue's High Grade Bone Superphosphate	1.56	1.68	1534
1537	Bone, Animal Matter, Kainit, etc	0.35	0.42	1537
1543	Vegetable Bone Superphosphate	5 07	5.15	1543
1546	Potato, Hop and Tobacco	2.31	2 43	1546

Station number.	Brand.	Per cent. of Nitrogen, Soda-Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
1549	Ammoniated Bone Superphosphate	2.66	2.65	1549
1551	Preston's Corn Fertilizer	2.70	2.76	1551
1558	Coe's Ammoniated Bone Superphosphate	1.72	1.80	1558
1559	" Excelsior Guano	3.36	3.31	1559
1561	Delta	2.59	2.72	1561
1567	Stockbridge Manure for Corn	3.15	3.21	1567
1568	Union County Fertilizer	1.44	1.48	1568
1569	Normal No. 1 Phosphate	2.50	2.41	1569
1573	Echo Superphosphate	0.92	1.12	1573
1582	Allen's Dried and Ground Fish	2.78	2.89	1582
1586	Chittenden's Fish and Potash	4.73	4.66	1586
1587	Bradley's Potato and Vegetable Manure	3.70	3.75	1587
1588	Stearn's Ammoniated Bone	2.63	2.64	1588
1591	Forrester's Potato Manure	4.59	4.58	1591
1595	Griffing's Superphosphate	2.29	2.32	1595
1600	Russel Coe's Ringoes Fertilizer	0.74	0.79	1600

HIGH GRADE NITROGENOUS MATERIALS.

Station No.	Brand.	Per cent. of Nitrogen, Soda-Lime.	Per cent. of Nitrogen, Kjeldahl.	Station No.
1138	Tankage	7.88	7.88	1138
1139	Dried Blood	14.21	14.26	1139
1148	Tankage	6.55	6.40	1148
1149	Dried Blood	10.02	10.11	1149
1158	Castor Pomace	4.71	4.68	1158
1167	Tankage	9.12	9.11	1167
1173	Hoof Meal	15.11	15.05	1173
1174	Tankage	8.71	8.55	1174
1176	Dried Ground Fish	9.12	9.05	1176
1186	Dried Blood	9.49	9.42	1186
1187	Prepared Blood and Animal Matter	6.44	6.35	1187
1195	Western Tankage (Hog)	6.07	6.11	1195
1196	Tankage Beef	3.31	3.35	1196
1197	Tankage (Hog)	4.88	4.93	1197
1201	Dried Blood	11.02	10.92	1201
1202	Ammonite	11.87	11.93	1202
1203	Tankage	3.09	3.19	1203
1204	Dried Ground Fish	8.52	8.50	1204
1212	Ammonite B	11.99	12.08	1212
1213	Swift Sure Guano	7.95	7.88	1213
1222	Ammonite	11.99	11.98	1222
1227	Azotine (Pork)	12.17	12.08	1227
1228	Dried Ground Fish	8.53	8.61	1228
1234	Tankage	6.11	6.14	1234
1241	A. A. Nitrogen	10.46	10.50	1241
1248	Dried and Ground Fish	8.34	8.34	1248

GROUND BONES AND MISCELLANEOUS SAMPLES.

Station number.	BRAND.	Per cent. of Nitrogen, Soda Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
1271	Ground Bone	4.09	4.00	1271
1308	" "	3.86	3.74	1308
1337	" "	3.91	3.87	1337
1349	" "	2.91	2.86	1349
1426	" "	5 62	5.55	1426
1427	" "	6.36	6.23	1427
1429	" "	1.64	1.55	1429
1457	" "	3.98	3.90	1457
1470	" "	3.37	3.32	1470
1492	" "	3.93	3.82	1492
1494	" "	3.95	3.83	1494
1518	" "	4.12	3.95	1518
1519	" "	1.73	1.67	1519
1527	" "	4.16	4.07	1527
1533	" "	4.00	3.90	1533
1538	" "	3.68	3.61	1538
1553	" "	4.18	4.09	1553
1579	" "	4.30	4.17	1579
1597	" "	1.64	1.76	1597
	MISCELLANEOUS.			
1350	Dried and Ground Fish	5.66	5.55	1350
1395	Rotted Bone Manure	2.59	2.50	1395
1539	Ammoniated Bone	2.43	2.31	1539
1562	" Dissolved Bone	1.97	1.94	1562
1578	$25 Phosphate	2.47	2.37	1578
1581	Dry Fish Scrap, California	9.92	9.94	1581
1582	Dried and Ground Fish	2.89	2.78	1582
1446	Ammoniated Dissolved Bone	1.55	1.48	1446

FODDERS.

Station number.	Brand.	Per cent. of Nitrogen, Soda Lime.	Per cent. of Nitrogen, Kjeldahl.	Station number.
338	Lucern	2.97	2.95	338
341	Clover	2.02	2.08	341
342	Lucern, 2d Cut	2.72	2.81	342
343	Hungarian Millet	0.93	0.99	343
344	Clover, 2d Cut	2.18	2.21	344
345	Hungarian Millet Seed	1.45	1.59	345
347	Lucern, 3d Cut	2.30	2.40	347
350	Corn Stalks	1.34	1.35	350
352	Hungarian Grass Hay	1.36	1.47	352
354	Buckwheat Straw	1.20	1.24	354
355	Oil Cake Meal	5.99	6.11	355
387	Orchard Grass Hay	0.98	1.06	387
391	Oat Straw	0.43	0.51	391
394	Timothy Hay	0.77	0.82	394
405	Bog Hay	1.04	1.02	405
410	Wheat Straw	0.43	0.47	410
411	Corn Stalks	0.54	0.55	411
417	Rye Straw	0.48	0.48	417
418	Creek Sedge	0.52	0.51	418
425	Timothy Hay	0.60	0.53	425
430	German Millet	0.75	0.73	430
431	Timothy Hay	0.75	0.73	431

APPENDIX.

ACT OF INCORPORATION.

The New Jersey Agricultural Experiment Station was established by authority of the following acts of the Legislature of the State:

CHAPTER CVI.

AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF AN AGRICULTURAL EXPERIMENT STATION.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey,* That for the benefit of practical and scientific agriculture, and for the development of our unimproved lands, the New Jersey Agricultural Experiment Station, with suitable branches, is hereby established.

2. *And be it enacted,* That the direction and management of this institution shall be committed to a Board of Directors, which shall consist of the Governor of the State, the Board of Visitors of the State Agricultural College, together with the President and the Professor of Agriculture of that institution.

3. *And be it enacted,* That the members of this Board shall be called together by the Secretary of the Board of Visitors, and shall organize by the election of a President and Secretary, who shall hold their offices for one year and until their successors are elected; five members shall constitute a quorum.

4. *And be it enacted,* That the Board of Directors shall hold a meeting each year, at Trenton, on the third Tuesday in January, and other meetings at the call of the President, at such times and places as may best promote the objects of the institution.

5. *And be it enacted,* That the Board of Directors shall locate said

Experiment Station and branches, and shall appoint a Director, who shall have the general management and oversight of the experiments and investigations necessary to carry out the objects of said institution, and shall employ competent chemists, and other assistants necessary to analyze soils, fertilizers and objects of agricultural interest, so as to properly carry on the work of the Station, and it shall make an annual report of its work to the Governor of the State.

6. *And be it enacted,* That a sum not exceeding five thousand dollars in any one year is hereby appropriated to said New Jersey Experiment Station, which money shall be paid out from the State Treasury on the presentation of the bills of said Station, properly certified by the President and Secretary of the Board of Directors.

7. *And be it enacted,* That this act shall take effect immediately.

Approved March 10th, 1880.

CHAPTER LXXXI.

A SUPPLEMENT TO THE ACT ENTITLED "AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF AN AGRICULTURAL EXPERIMENT STATION," APPROVED MARCH TENTH, ONE THOUSAND EIGHT HUNDRED AND EIGHTY.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey,* That from and after the passage of this act, the Board of Directors, mentioned and created by said act, shall be called and known as the Board of Managers.

2. *And be it enacted,* That in addition to the powers now conferred upon said Board, they shall have power to elect a Treasurer, who shall hold his office for one year and until his successor shall be elected and qualified; and to appoint such other officers and agents as may be necessary to carry on the business of the institution; and to make such rules, by-laws and regulations for the government of the Board, and for carrying out the objects, business and purposes of the institution, as may, in their judgment, be necessary and proper.

3. *And be it enacted,* That the annual appropriation for the support of the New Jersey Agricultural Experiment Station be and the same is hereby increased from its present sum of five thousand dollars a year to eight thousand dollars a year.

4. *And be it enacted,* That this act shall take effect immediately.

Approved March 9th, 1881.

CHAPTER CCVIII.

A SUPPLEMENT TO THE SUPPLEMENT TO AN ACT ENTITLED "AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF AN AGRICULTURAL EXPERIMENT STATION," APPROVED MARCH NINTH, ONE THOUSAND EIGHT HUNDRED AND EIGHTY-ONE.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey,* That section three of the supplement to the act entitled "An act to provide for the establishment of an Agricultural Experiment Station," be amended so as to read as follows:

3. *And be it enacted,* That the expenses of said Station, when presented to the Comptroller of the State, accompanied by the proper vouchers, duly certified by the President and Secretary of the Board of Directors, shall, upon warrant of said Comptroller, be paid out of the State Treasury; *provided,* such expenses do not exceed the sum of eleven thousand dollars in any year.

2. *And be it enacted,* That this act shall take effect immediately.

Approved May 9th, 1884.

◆

LAWS OF NEW JERSEY.

AN ACT TO REGULATE THE MANUFACTURE AND SALE OF FERTILIZERS.

1. That every commercial fertilizer which shall be offered for sale in this State shall be accompanied by an analysis, stating the percentage therein of ammonia, or its equivalent of nitrogen; of potash, in any form or combination, soluble in distilled water; and of phosphoric acid in any form or combination; the portion of phosphoric acid soluble in distilled water; that portion soluble in a neutral solution of citrate of ammonia at a temperature not exceeding one hundred degrees Fahrenheit; and that portion of phosphoric acid not soluble in either of the above-named fluids, shall each be determined separately; and the material from which the phosphoric acid is obtained shall also be stated; a legible statement of such analysis

shall accompany all packages or lots of over one hundred pounds, sold, offered or exposed for sale.

2. That the Chemist of the State Board of Agriculture shall be the Inspector of Fertilizers; it shall be his duty to analyze one or more samples of every kind of commercial fertilizers coming within the provisions of this act, which may be offered for sale within the State, and of which he shall be informed.

3. That manufacturers, dealers, and all persons interested, may obtain an analysis by notifying the Chemist of the State Board of Agriculture, upon which notification he shall be authorized to analyze, at his discretion, samples selected by himself, and to furnish certified copies of such analysis to the persons on whose application they were made; and it shall also be his duty to report all such analyses to the State Board of Agriculture.

4. That the Chemist of the State Board of Agriculture shall receive for each certificate of analysis made by him a sum not to exceed fifteen dollars, to be paid by the person or persons applying therefor.

5. That any person selling, offering or exposing for sale any commercial fertilizer without the analysis required by the first section of this act, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense.

Approved March 24th, 1874.

SUPPLEMENT.

SEC. 1. That the penalty or penalties prescribed in section five of that act may be sued for and recovered, in an action of debt, in any court of competent jurisdiction in this State, in the name of any person who will sue for the same, one-half thereof for his own use, and the other half to be paid to the county superintendent of public schools of the county in which such suit or suits shall be brought, for the use of the public schools in their county.

Approved March 31st, 1875.

A SUPPLEMENT TO AN ACT ENTITLED "AN ACT TO REGULATE THE MANUFACTURE AND SALE OF FERTILIZERS," APPROVED MARCH TWENTY-FOURTH, ONE THOUSAND EIGHT HUNDRED AND SEVENTY-FOUR.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey,* That the fifth section of the act to which this act is a supplement, which section now reads as follows:

" 5. *And be it enacted,* That any person selling, offering or exposing for sale any commercial fertilizer without an analysis required by the first section of this act, or with an analysis stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense," be and the same is hereby amended so as to read as follows:

5. *And be it enacted,* That any person selling, offering or exposing for sale any commercial fertilizer without an analysis required by the first section of this act, or the act to which this act is a supplement, or with an analysis stating that the said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, shall forfeit fifty dollars for the first offense and one hundred dollars for each subsequent offense; *provided further,* that the provisions of this section, or the act to which this act is a supplement, shall not apply to any manure sold at a price not exceeding one-half a cent per pound, nor to any imported guanos.

2. *And be it enacted,* That this act shall take effect immediately.

Approved March 27th, 1878.

DIRECTIONS TO BE FOLLOWED IN SAMPLING FERTILIZERS.

Inspectors may sample fertilizers found either
1—upon farms,
2—in dealers' storehouses, or,
3—in manufactories.

The Station prefers that samples should be drawn either upon farms or in dealers' storehouse.

In sampling fertilizers found upon farm, inspectors should ascertain,
1st, that the farmer has received these fertilizers *during the present season,*
2d, that they were received in good condition; and have since been so stored that a noticeable gain or loss of moisture has been prevented.

In no case should farm samples be taken from stock of a past season or from stock which is or has been carelessly stored.

In sampling from *dealers' storehouses,* inspectors should also ascertain whether the fertilizers are of old (last season's) or of new stock. Preference should always be given to the present season's goods. Circumstances may, however, make it advisable to sample old stock; in such cases, this fact must be distinctly stated by the inspector, in his report to the Station's Director.

If for any reason it is found to be necessary to draw samples at factories, inspectors should decline,
1st, to sample from piles of fertilizers;
2d, to sample from bags which are not distinctly marked with the brand, the manufacturer's name and the guaranteed analysis.

If fertilizers are found stored in piles only, inspectors should cause six or more bags to be filled from different portions of the piles; from these bags the samples may be drawn in the usual manner.

SAMPLING.

Whenever the mechanical condition will allow samples should be drawn by means of the *sampling tube.*

This tube is formed to a sharp point at one end, and can be forced to the bottom of a bag or barrel. A slot extending nearly its entire length can then be opened and the tube allowed to fill with the fertilizer. When the slot is closed and the tube withdrawn, it will contain a fair sample of any given package.

It is not desirable to sample lots of less than one-half ton of any one brand. In such lots portions may be taken from each bag; in larger lots each fifth or tenth bag may be opened. The several portions representing the same brand should then be carefully mixed and a quart fruit jar filled, securely closed and marked with labels furnished by the Station.

As soon as a sample has been taken, and *invariably* before bags of another have been opened, the inspector should carefully filled out the blank describing samples.

He should copy *from the bags,*
1st, the brand,
2d, the name of the manufacturer,
3d, the guaranteed analysis.

Any other information desired can be sought from the owner of the fertilizer.

Each sample bottle should be carefully wrapped in heavy paper, and packed for transportation in a wooden box, properly closed. This box should be forwarded by express, directed to

THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION,
GEORGE H. COOK, DIRECTOR,
New Brunswick, N. J.

FERTILIZERS.

FORM FOR DESCRIPTION OF SAMPLE.

The person sending samples to the Station for analysis without charge, will be provided with a form like this for each sample, and must fill up every one of the blank particulars given, so as to make the description complete and definite, and in every case write his signature, as endorsing the accuracy of it. As there is much responsibility in taking fair average samples, such as will justly represent the manufacturer as well as the consumer, it is very important that every precaution be taken, so that in case of a suit at law the person signing the description can testify to its accuracy. The writing should be plain and legible. The filled out form, if wrapped with the sample, will serve as a label. If any printed circular, pamphlet, analysis or statement accompanies the fertilizer, or is used in its sale, send a copy with the specimen.

1. *Brand of Fertilizer*..

2. *Name and address of Manufacturer*..

....

3. *Name and address of Dealer from whose stock this sample is taken*..........

....

4. *Date of taking this sample*..

5. *Selling price per ton, hundred, bag or barrel*...............................

6. *Selling weight claimed for each package weighed*............................

7. *Actual weights of packages opened*..

8. *Copy of analysis or composition affixed to packages of this Fertilizer*.....

....

....

....

9. *Signature of person taking sample*..

P. O. Address..

FODDERS AND FEEDS.

FORM FOR DESCRIPTION OF SAMPLE.

The person sending samples to the Station for analysis without charge, will be provided with a form like this for each sample, and must fill up every one of the blank particulars given, so as to make the description complete and definite, and in every case write his signature, as endorsing the accuracy of it. As there is much responsibility in taking fair average samples, such as will justly represent the manufacturer as well as the consumer, it is very important that every precaution be taken, so that in case of a suit at law the person signing the description can testify to its accuracy. The writing should be plain and legible. The filled out form, if wrapped with the sample, will serve as a label. If any printed circular, pamphlet, analysis or statement accompanies the sample, or is used in its sale, send a copy with the specimen.

1. *Brand of Fodder or Feed* ....

2. *Name and address of Manufacturer*..

....

3. *Name and address of Dealer from whose stock this sample is taken*...............

....

4. *Date of taking this sample*...

5. *Selling price ton, hundred, bag or barrel*...

6. *Selling weight claimed for each package weighed* ....

7. *Actual weights of packages opened*..

8. *Copy of analysis or composition affixed to packages of this sample*.................

....

....

....

9. *Signature of person taking sample*...

P. O. Address..

ORDER OF STATION WORK.

The largest portion of the Station work is in the Analysis of Fertilizers, Field Experiments, Feeding Experiments, with Analyses of Foods, Fodders, Milk, &c. To do these branches of work well, continuous and steady attention must be given to each of them while it is in progress, and other business has to be laid aside for the time. To make this necessary order of work as little disappointing as possible for those who desire work at the Station, we publish this statement of the subjects upon which we propose to work at the different periods of the year:

Feeding Experiments	January and February.
Analyses of Fertilizers	March to September 15th.
Field Experiments	April and May.
Field Experiments	Sept. 15th to Nov. 30th.
Annual Report	December.

Miscellaneous work of various kinds may arise to interfere with the perfect regularity of this plan, but for accomplishing the largest amount of work it will be necessary to adhere as closely to it as possible.

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